Posterior Abdominal Wall

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Lecture (5) – Last updated: June 2013

Objectives:

- **Basic anatomy, to identify:**
  - **Parts, blood supply and innervation of the kidneys, ureters and sprsrenal glands.**
  - **Arteries and thie branches ad veins and their tributaries in the posterior abdominal wall.**
  - **Nerves in the posterior abdominal wall and their roots.**
- **Clinical anatomy, to define:**
  - **Urinary tract stones.**
  - **IVU.**
- **Surface anatomy, to define:**
  - **Surface marking of kidneys and ureters**
- **Radiology, to define:**
  - **Retrograde pyelogram**

Think About This

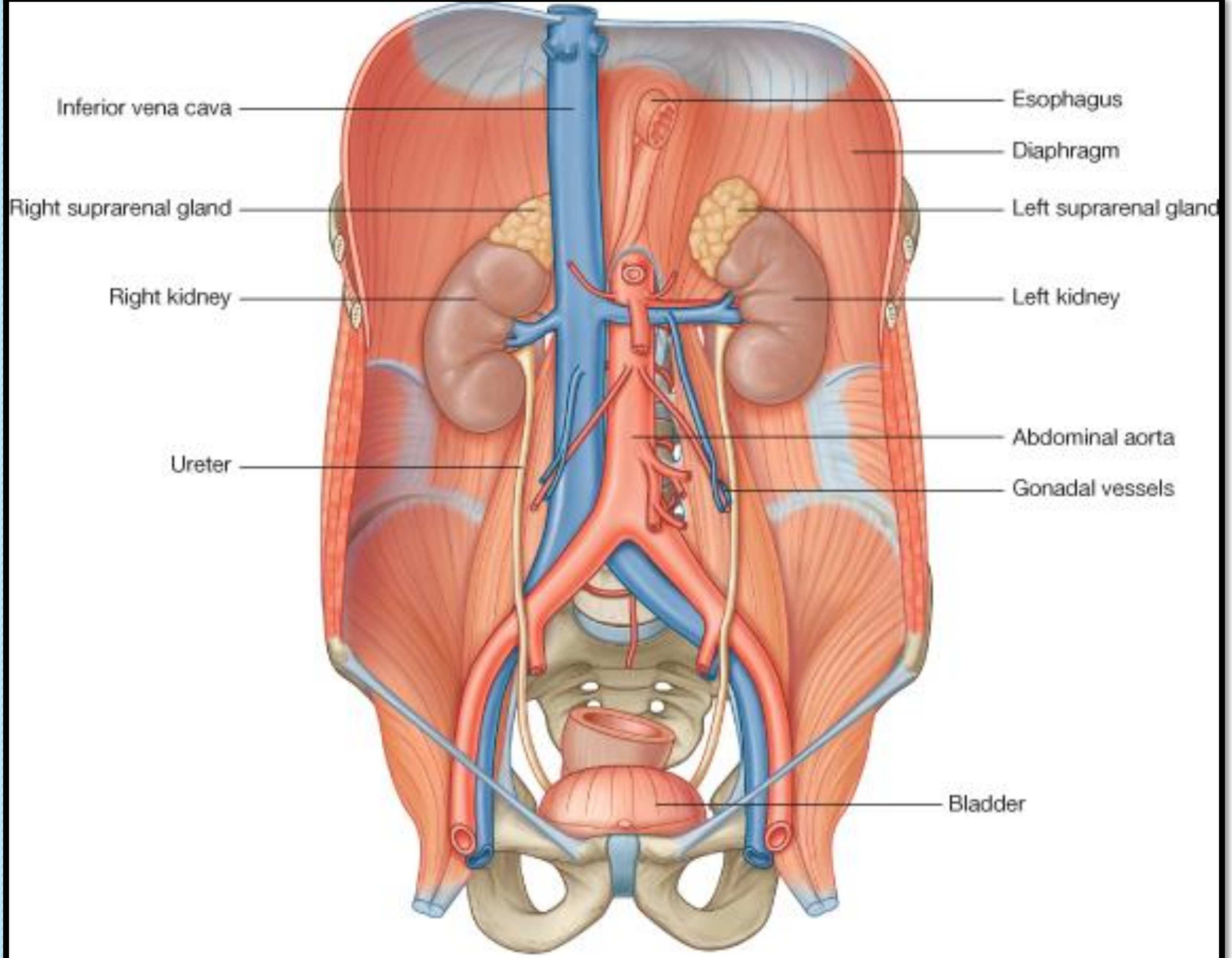
- **Atif is 40 years –old construction worker rushed to the hospital C/O severe abdominal pain in the left side of his abdomen; the pain sometimes shows in his groin, he also complained of presence of blood in urine.**
- **O/E the doctor detected rigidity of the lateral abdominal muscles, he requested radiological instigation before making the diagnosis: ureteric colic.**

By The End Of This Lecture, Try To Answer These Questions About The Previous Story:

1. Mention the surface marking of the ureter.
2. What are the spinal cord segments (levels) in which afferent fibers of the ureters return to?
3. Why did he feel pain in his groin?
4. What type of radiological investigation did the doctor request?

Introduction: lecture's map

- Kidneys and ureters.
- Blood vessels.
- Muscles.
- Nerves.



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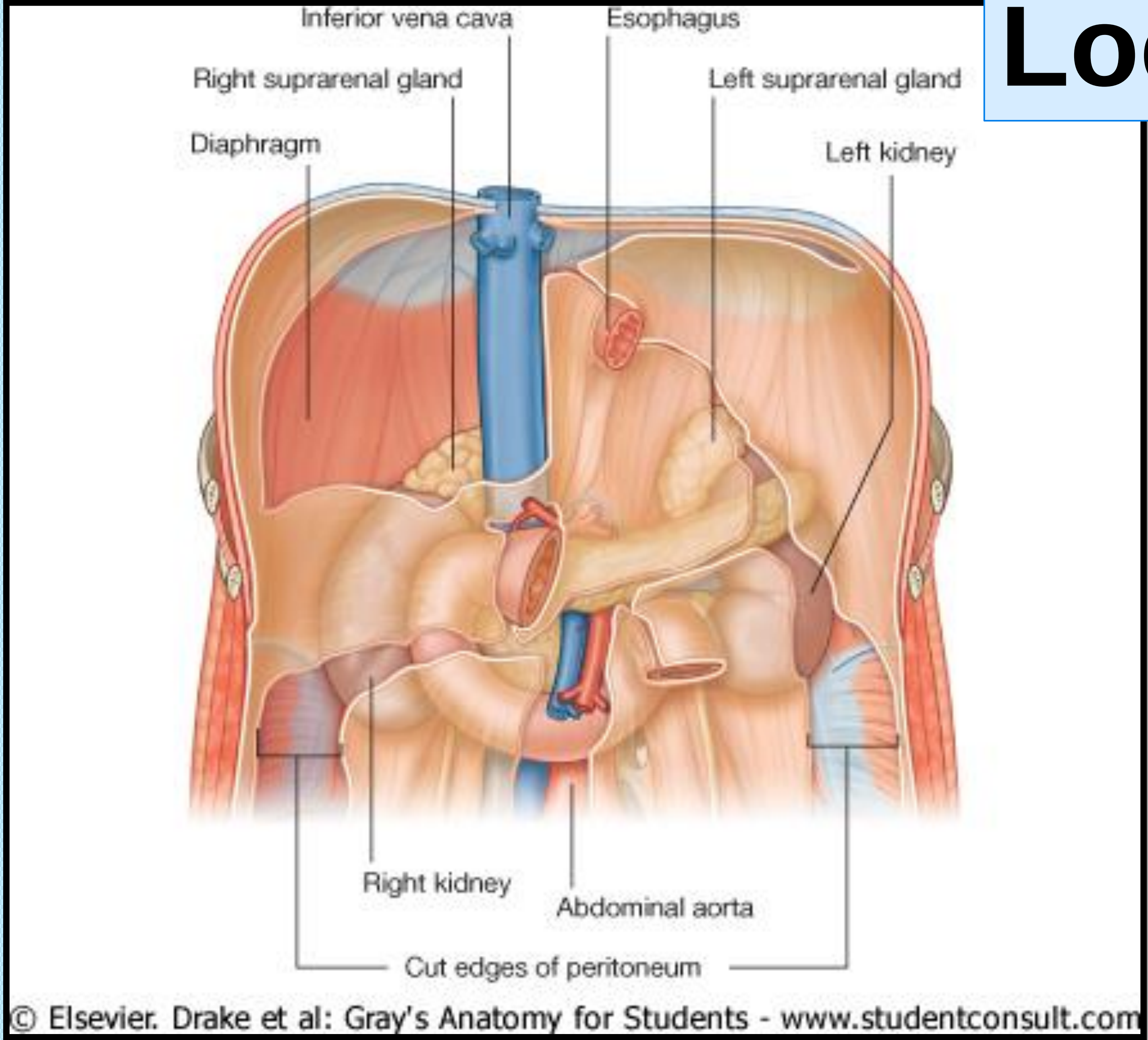
KIDNEYS AND URETERS

Location


Inferior vena cava
Esophagus
Right suprarenal gland
Left suprarenal gland
Diaphragm
Left kidney
Right kidney
Abdominal aorta
Cut edges of peritoneum
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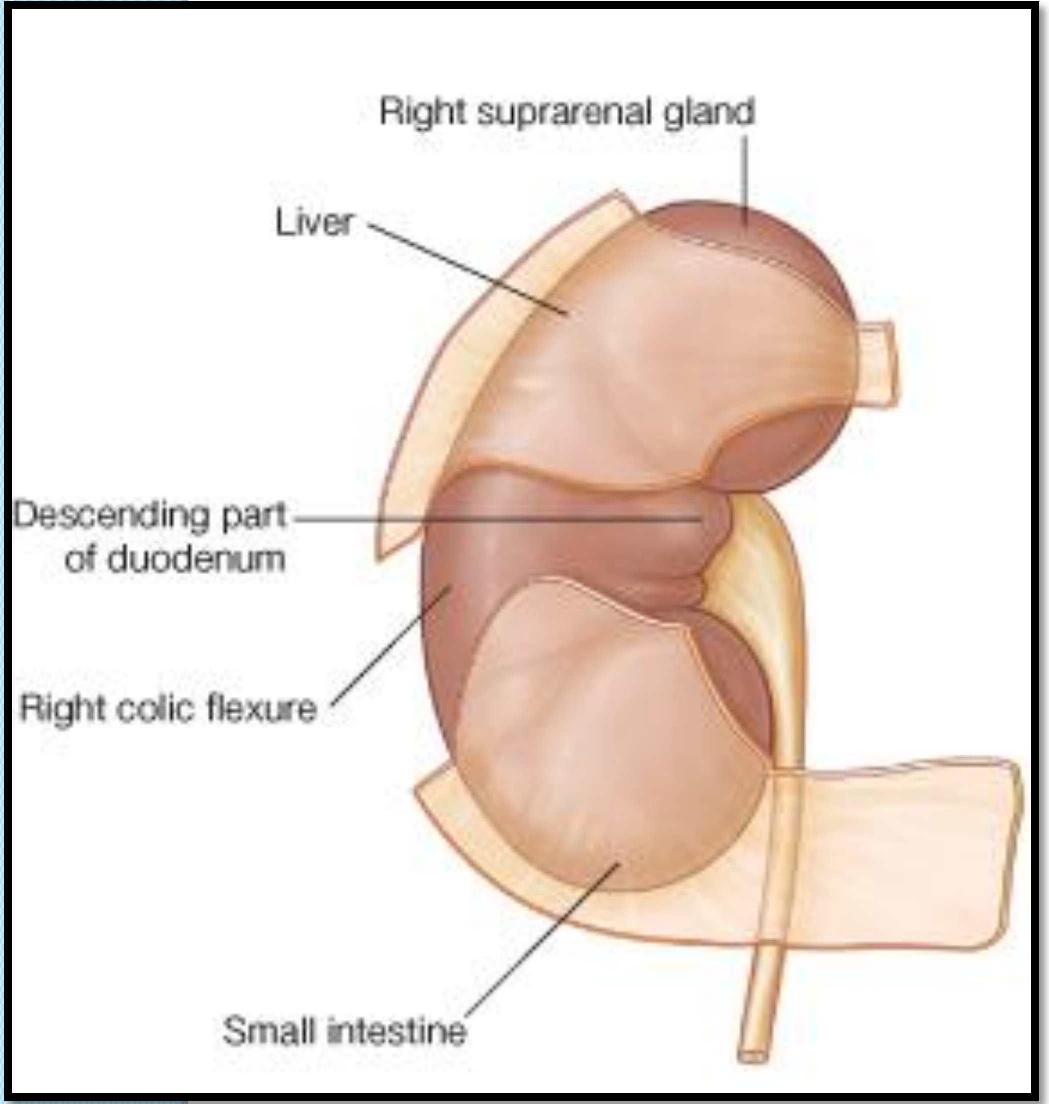
Kidneys

- They are extraperitoneal.
- Extend from vertebra T12 superiorly to vertebra L3 inferiorly.
- The right kidney is lower than the left.

Anterior Relations Of The Right Kidney

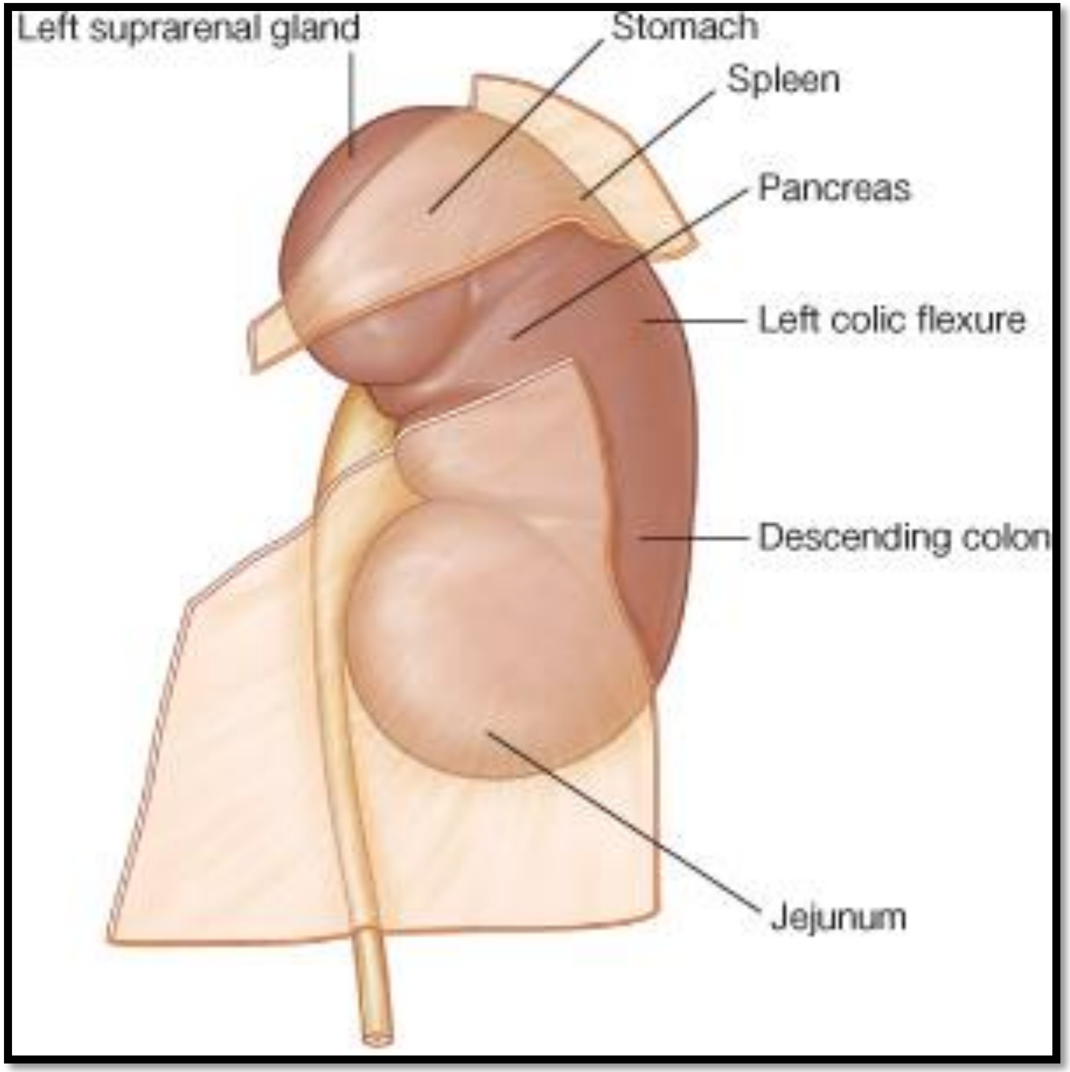


- The right suprarenal gland.
- The liver.
- The descending part of the duodenum.
- The right colic.
- The small intestine.

Image from: Richard L.Drake, Wayne Vogl,Adam W.M.Mitchell, GRAYS anatomy for students, Elsevier Inc. 2007

Anterior Relations Of The Left Kidney

- **The left suprarenal gland.**
- **The stomach.**
- **The spleen.**
- **The pancreas .**
- **The left colic flexure .**
- **The jejunum.**



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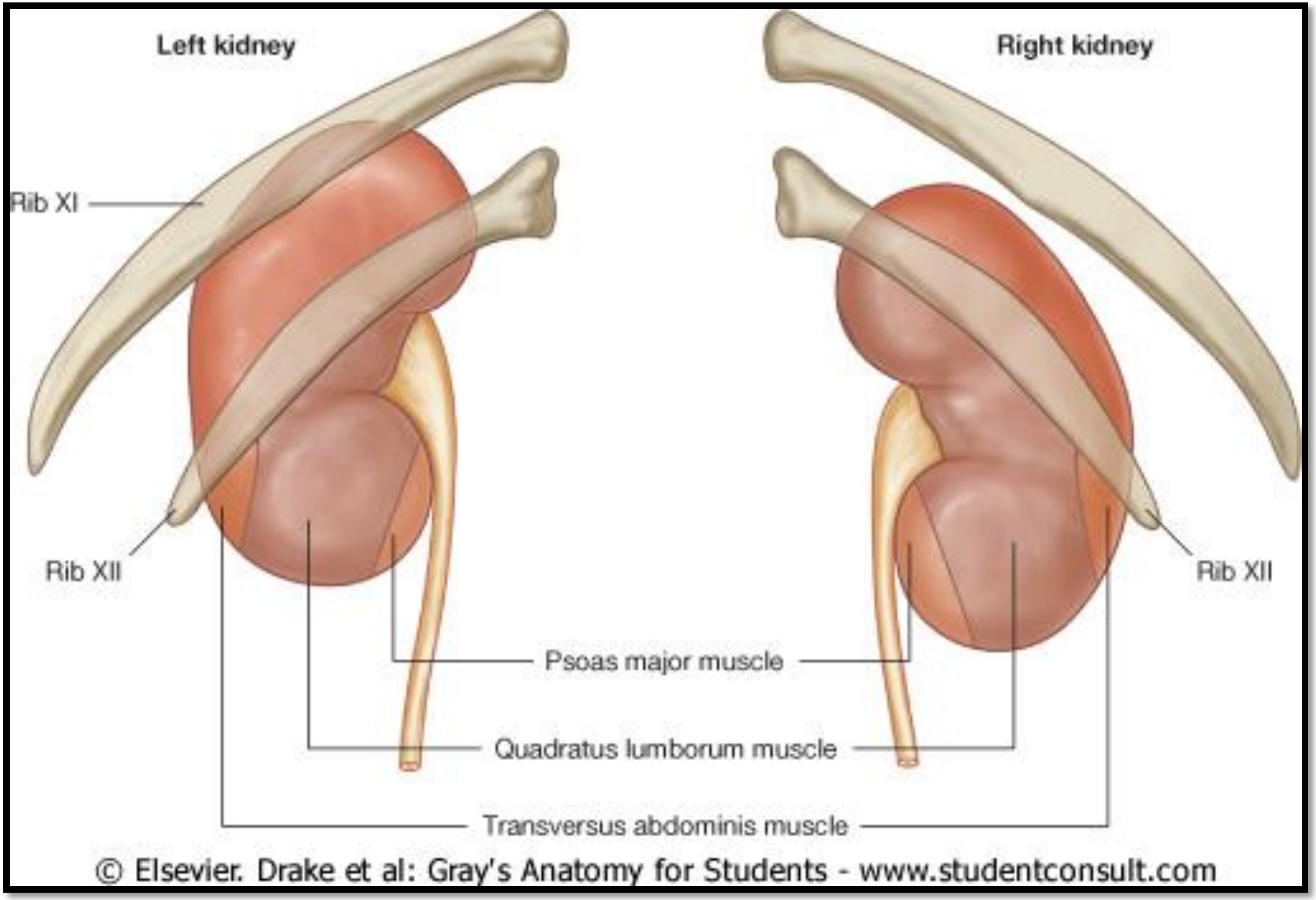
Posterior Relations Of The Kidneys



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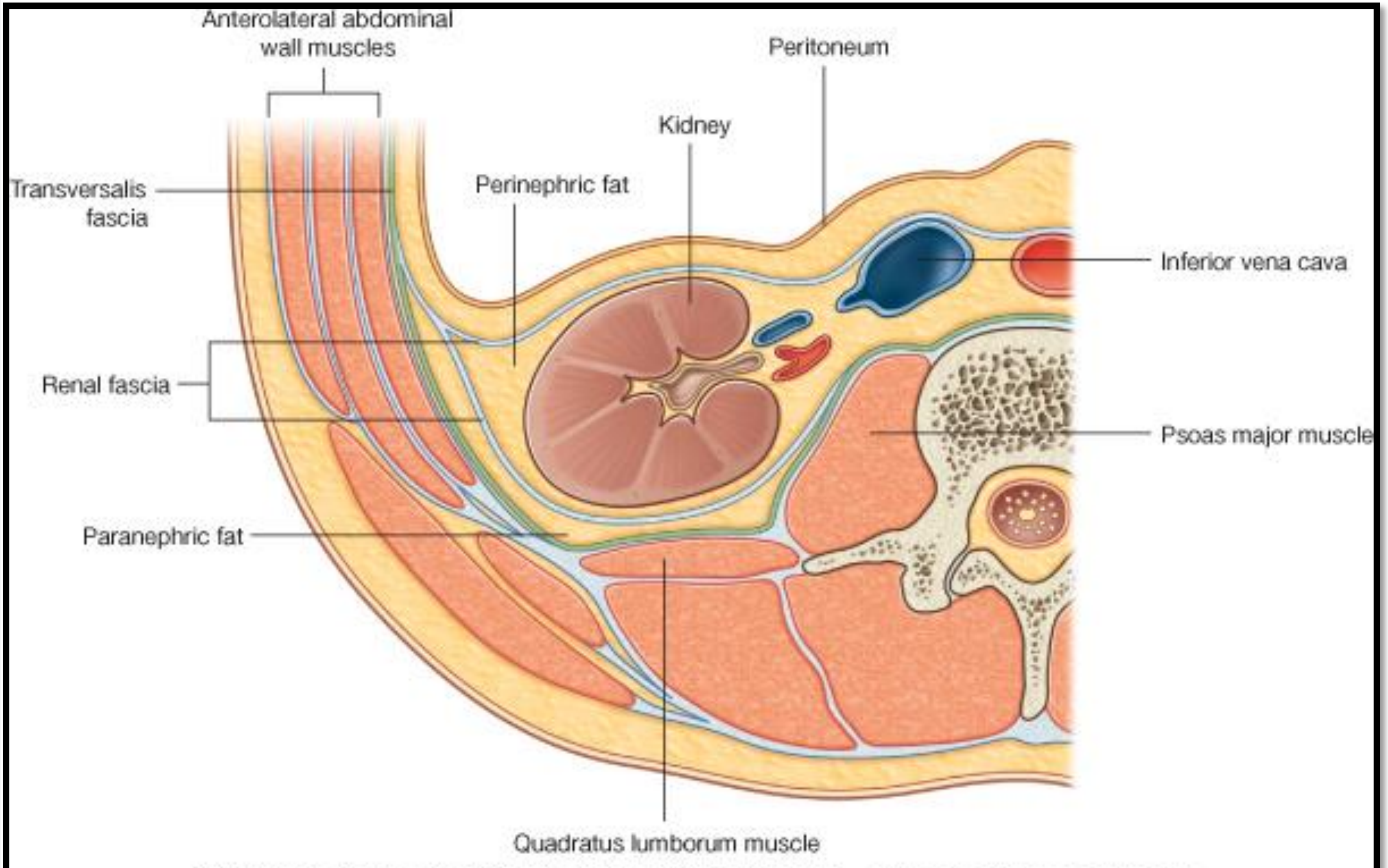
Renal fat and fascia



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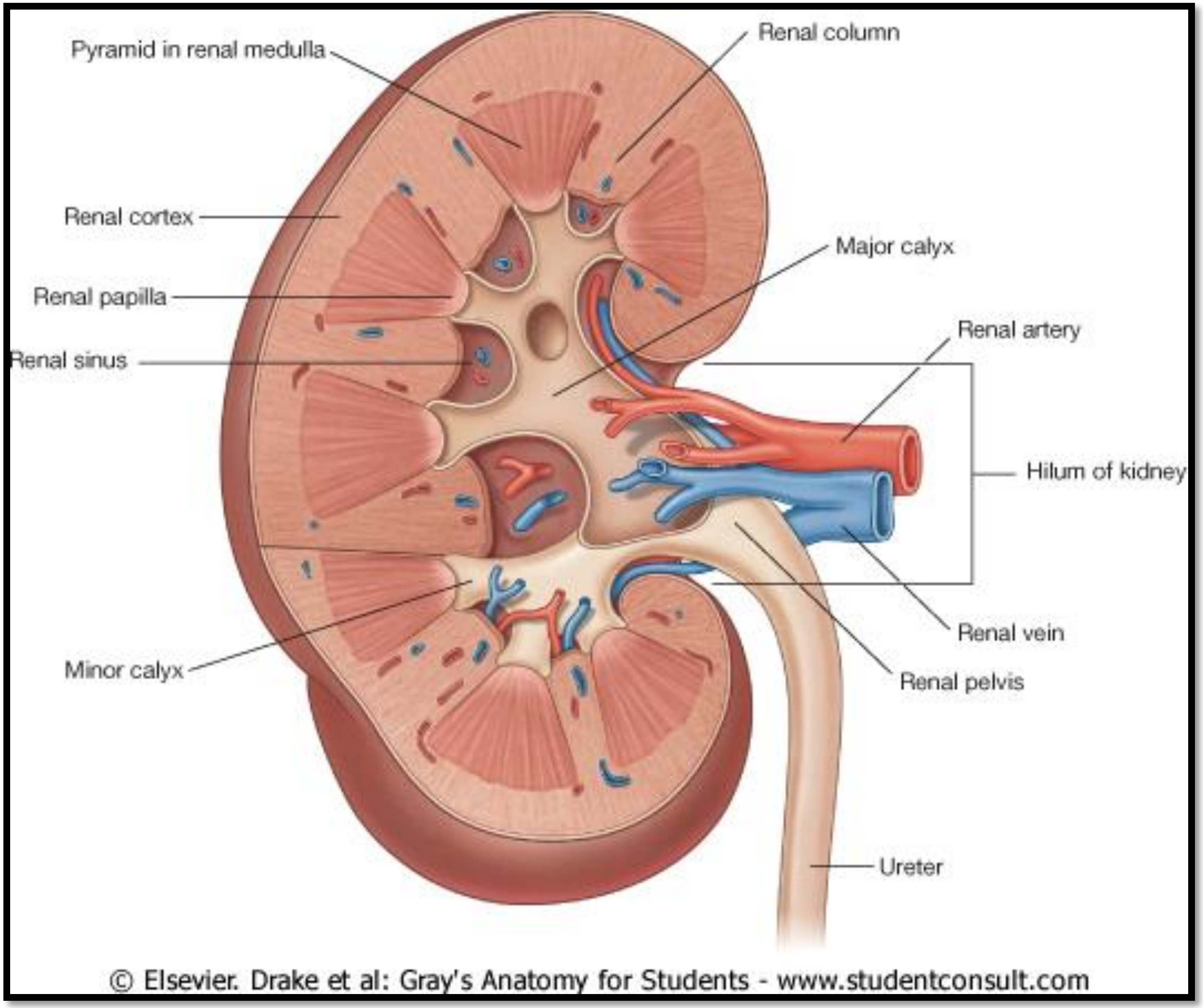
Renal fat and fascia

- **From within to outside:**
    - **The renal capsule.**
    - **The peri-nephric fat (peri-renal fat).**
    - **The renal fascia.**
    - **Para-nephric fat (para-renal fat).**

Structure Of The Kidney



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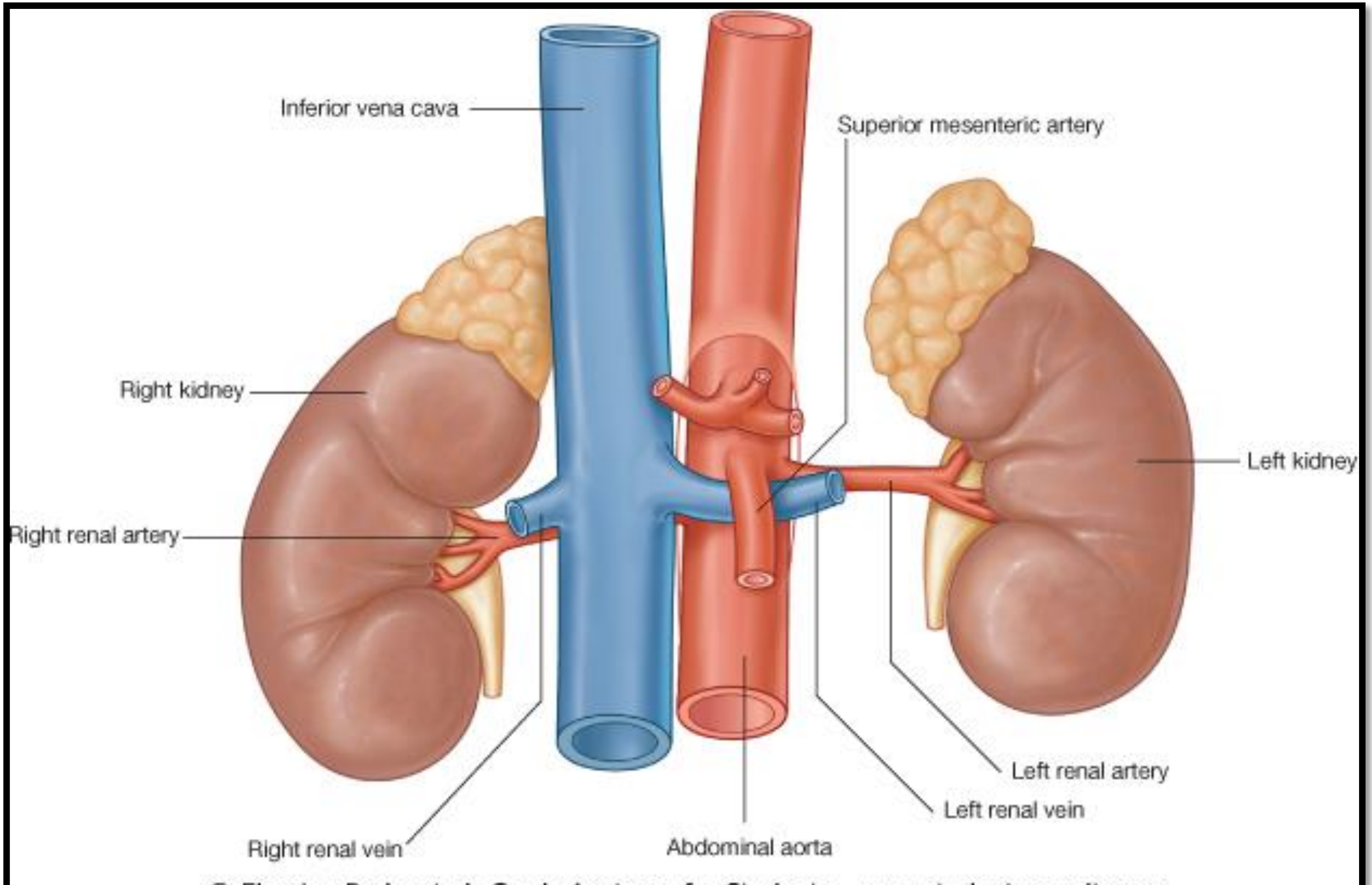
Structure Of The Kidney

- **The renal cortex:**
  - **The renal columns.**
- **The renal medulla:**
  - **The renal pyramids.**
  - **The renal papilla.**
  - **Minor calyx.**
  - **Major calyx.**

Vessels Of The Kidneys



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Think about this

- The right renal artery is longer than the left.
- The left renal vein is longer than the right.

Why?

Suprarenal Glands

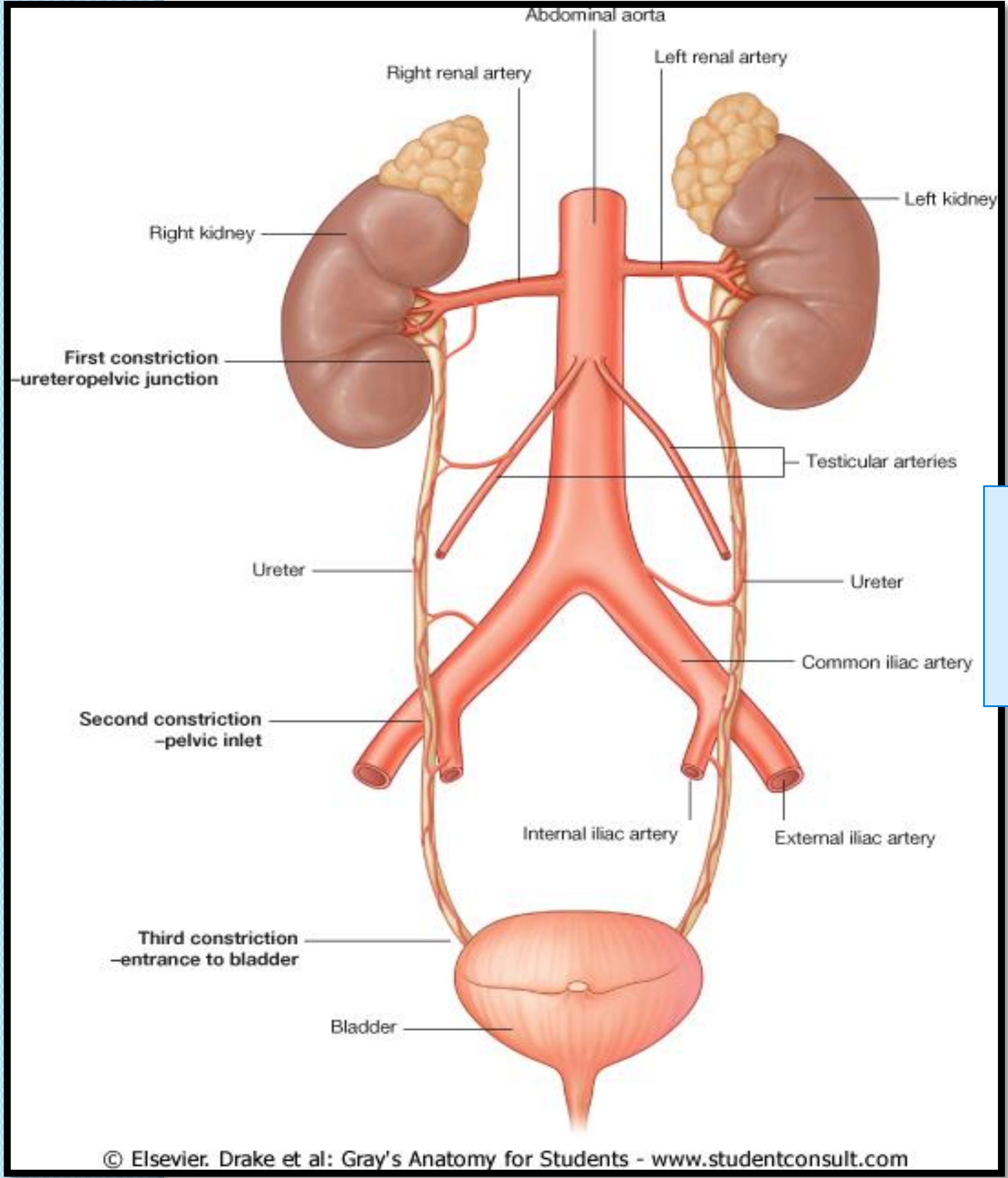
- They are associated with the superior pole of each kidney. They consist of an outer cortex and an inner medulla.

Suprarenal Glands

- The right gland is shaped like a pyramid.
- Anterior to it is part of the right lobe of the liver and the inferior vena cava.

- The left gland is semilunar in shape and larger.
- Anterior to it is part of the stomach, pancreas, and, on occasion, the spleen.

Ureters



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Ureteric Constrictions

- **At the ureteropelvic junction.**
- **At the pelvic brim: where the ureters cross the common iliac vessels.**
- **Where the ureters enter the wall of the bladder.**

Blood Supply

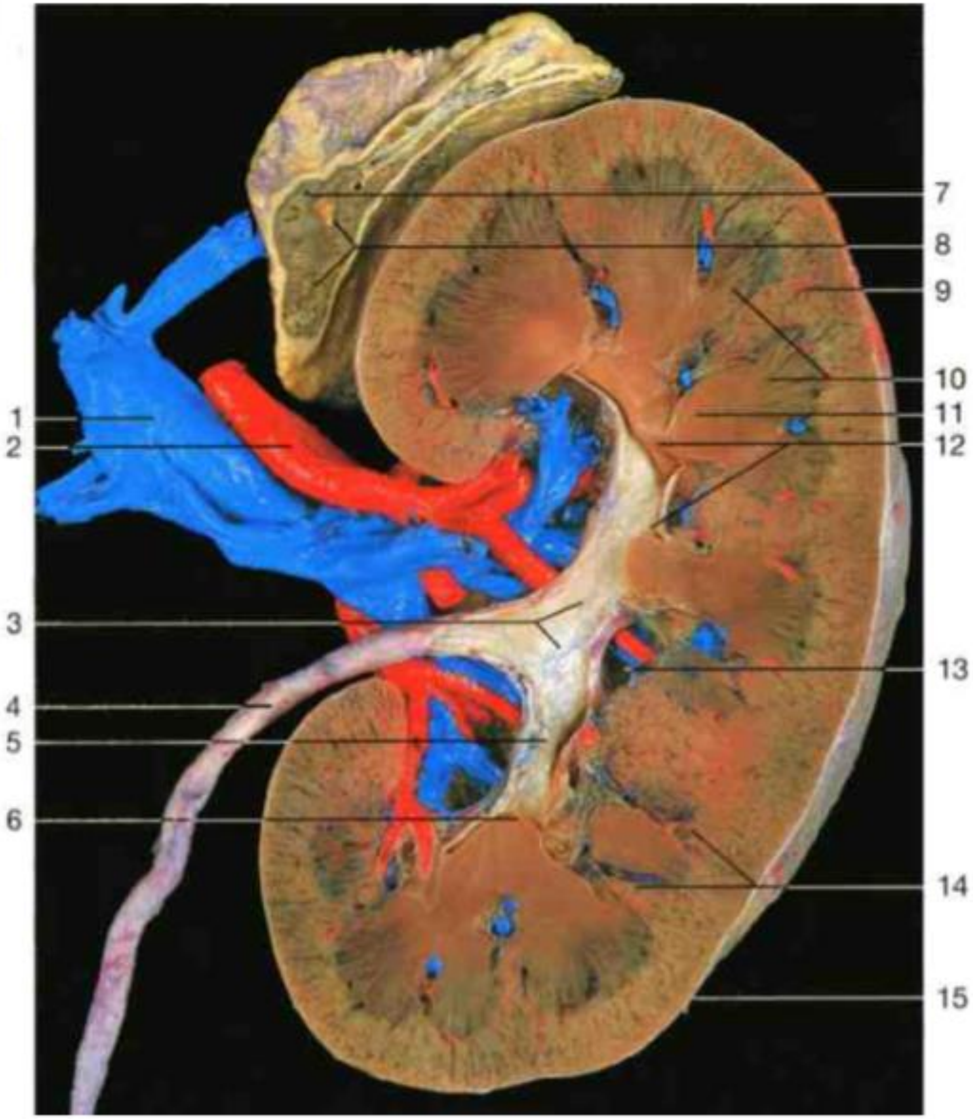
- **The upper end:**
  - **The renal arteries.**
- **The middle part: Branches from:**
  - **The abdominal aorta.**
  - **The testicular or ovarian arteries.**
  - **The common iliac arteries.**
- **The lower part:**
  - **Branches of the internal iliac arteries.**

Innervation

- **Sympathetic and parasympathetic from:**
  - **Renal, aortic, superior hypogastric, and inferior hypogastric plexuses through nerves that follow the blood vessels.**
- **Visceral afferent fibers return to T11 to L2 spinal cord levels.**

Clinical Note: Urinary Tract Stones

- Occur more frequently in men than in women.
- The stones are polycrystalline aggregates of calcium, phosphate, oxalate, urate, and other soluble salts within an organic matrix.
- The typical presentation is a patient with pain that radiates from the infrascapular region (loin) into the groin. Blood in the urine (hematuria) may also be noticed.

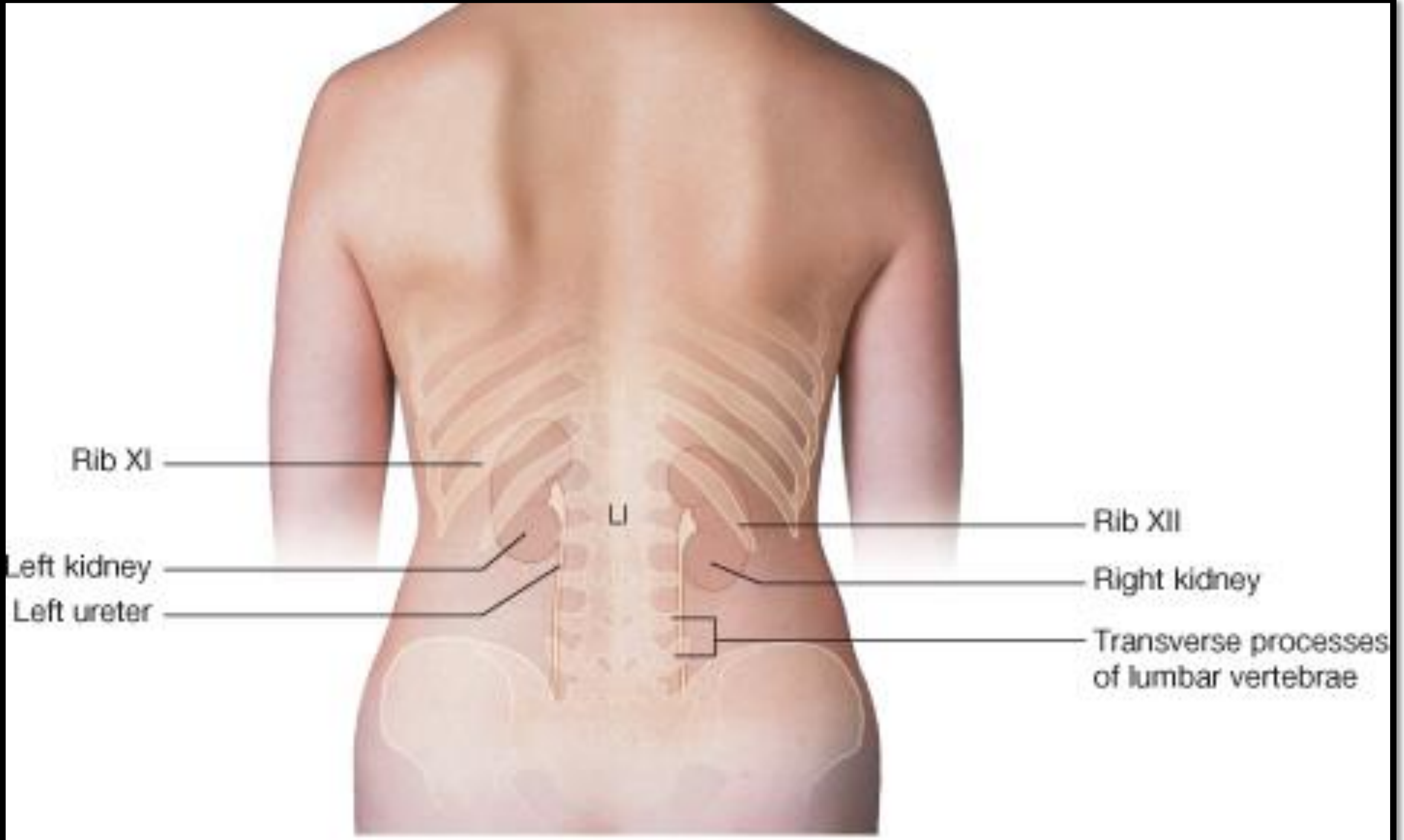


1	Renal vein
2	Renal artery
3	Renal pelvis
4	Abdominal part of ureter
5	Major renal calyx
6	Cribriform area of renal papilla
7	Cortex of suprarenal gland
8	Medulla of suprarenal gland
9	Cortex of kidney
10	Medulla of kidney
11	Renal papilla
12	Minor renal calyx
13	Renal sinus
14	Renal columns
15	Fibrous capsule of kidney

Coronal section through right kidney and suprarenal gland (posterior aspect). The renal pelvis has been opened and the fatty tissue removed to display the renal vessels.

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

Surface Marking: Kidneys And Ureters



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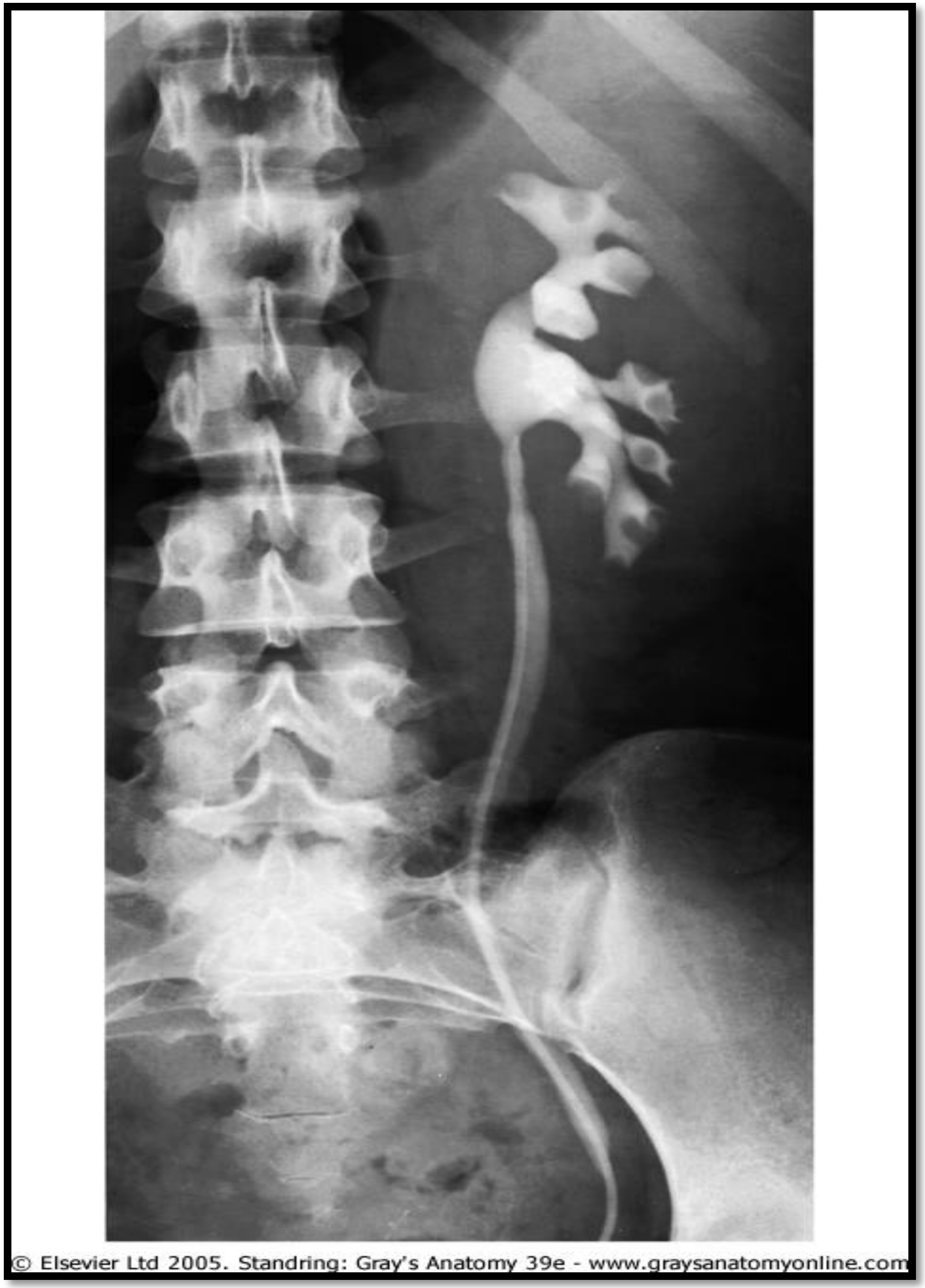
A left retrograde pyelogram. Contrast medium which has been introduced into the calyces, pelvis and upper ureter via a ureteric catheter can be clearly identified.

This technique affords better visualization of the calyces than can be achieved by the intravenous method.

Note the relation of the ureter to the tips of the lumbar transverse.



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Clinical note: IVU (intravenous urogram)

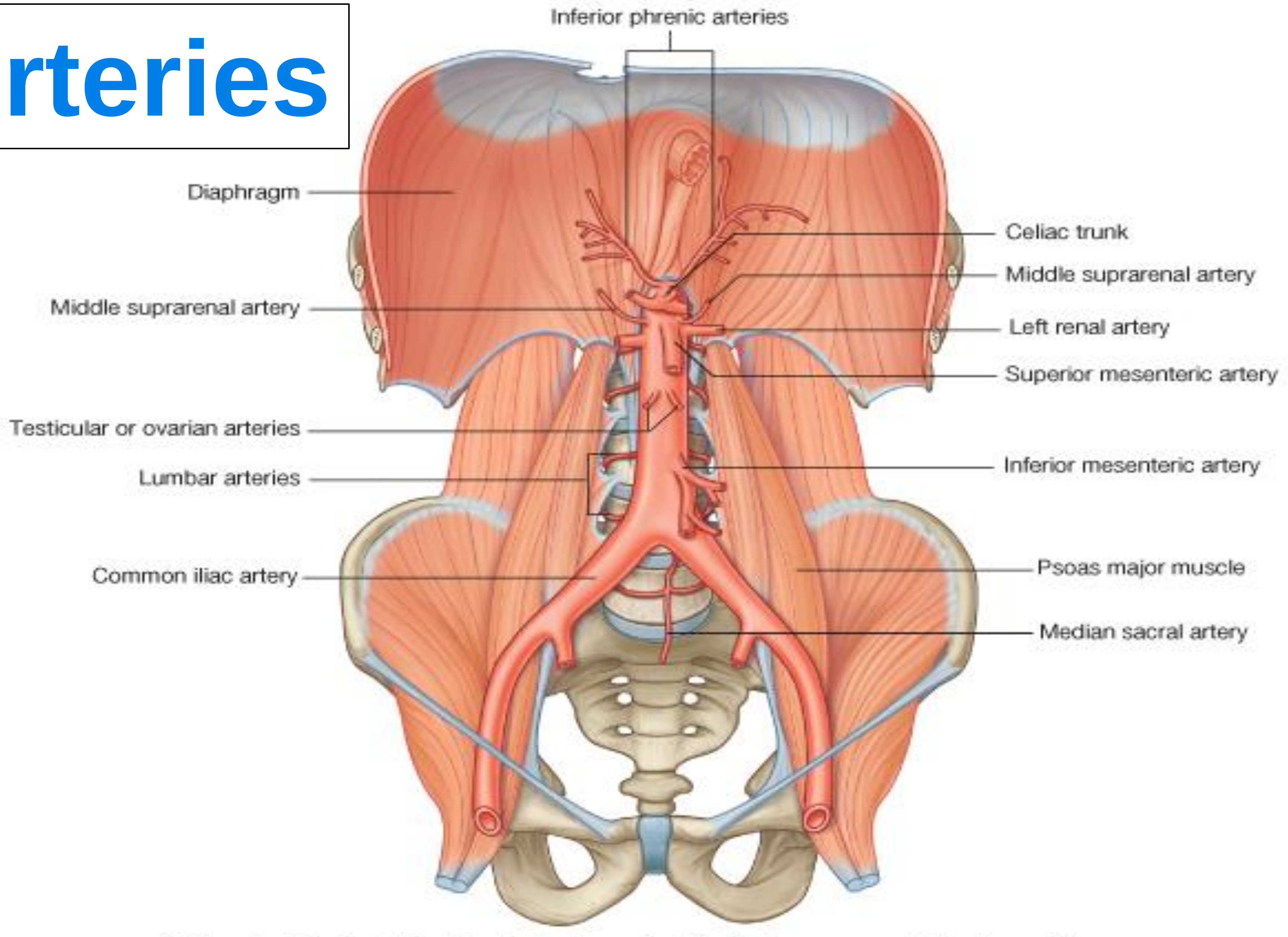
- It is a radiologic investigations.
- The patient is injected with iodinated contrast medium.
- After intravenous injection, contrast media are excreted predominantly by glomerular filtration.
- This allows for the visualization of the collecting system as well as the ureters and bladder.

Lecture's map

- Kidneys and ureters.
- **Blood vessels.**
- **Muscles.**
- **Nerves.**

BLOOD VESSELS

Arteries



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Abdominal Aorta (Anterior Branches)

Artery	Origin	Parts supplied
Celiac trunk	Immediately inferior to the aortic hiatus of the diaphragm	Abdominal foregut
Superior mesenteric artery	Immediately inferior to the celiac trunk	Abdominal midgut
Inferior mesenteric artery	Inferior to the renal arteries	Abdominal hindgut

Abdominal Aorta (Lateral Branches)

Artery	Origin	Parts supplied
Middle suprarenal arteries	Immediately superior to the renal arteries	Suprarenal glands
Renal arteries	Immediately inferior to the superior mesenteric artery	Kidneys

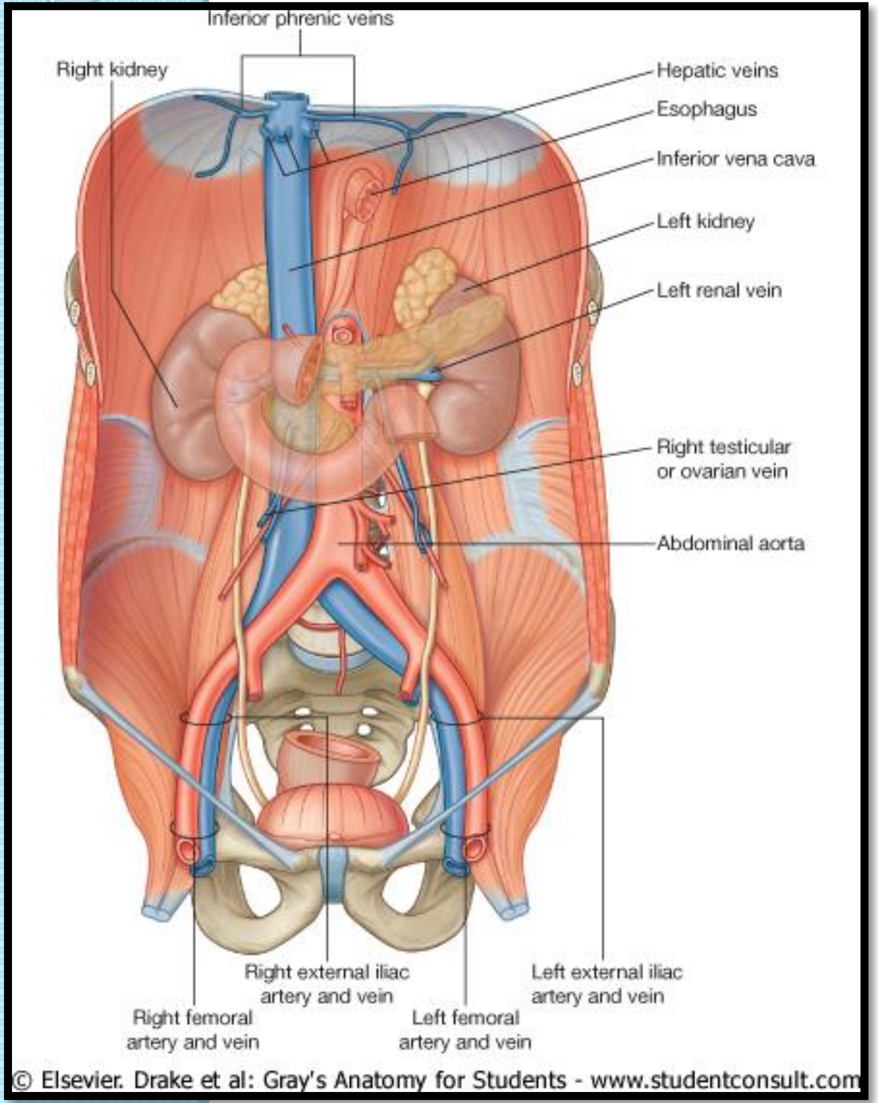
Abdominal Aorta (Paired Branches)

Artery	Origin	Parts supplied
Testicular or ovarian arteries	Inferior to the renal arteries	Testes in male and ovaries in female
Inferior phrenic arteries	Immediately inferior to the aortic hiatus	Diaphragm

Abdominal Aorta (Posterior And Terminal Branches)

Artery	Branch	Origin	Parts supplied
Lumbar arteries	Posterior	Usually four pairs	Posterior abdominal wall and spinal cord
Median sacral arteries	Posterior	Just superior to the aortic bifurcation, pass inferiorly across lumbar vertebrae, sacrum, and coccyx	
Common iliac arteries	Terminal	Bifurcation usually occurs at the level of LIV vertebra	

The Inferior Vena Cava


Inferior phrenic veins
Right kidney
Hepatic veins
Esophagus
Inferior vena cava
Left kidney
Left renal vein
Right testicular or ovarian vein
Abdominal aorta
Right external iliac artery and vein
Left external iliac artery and vein
Right femoral artery and vein
Left femoral artery and vein

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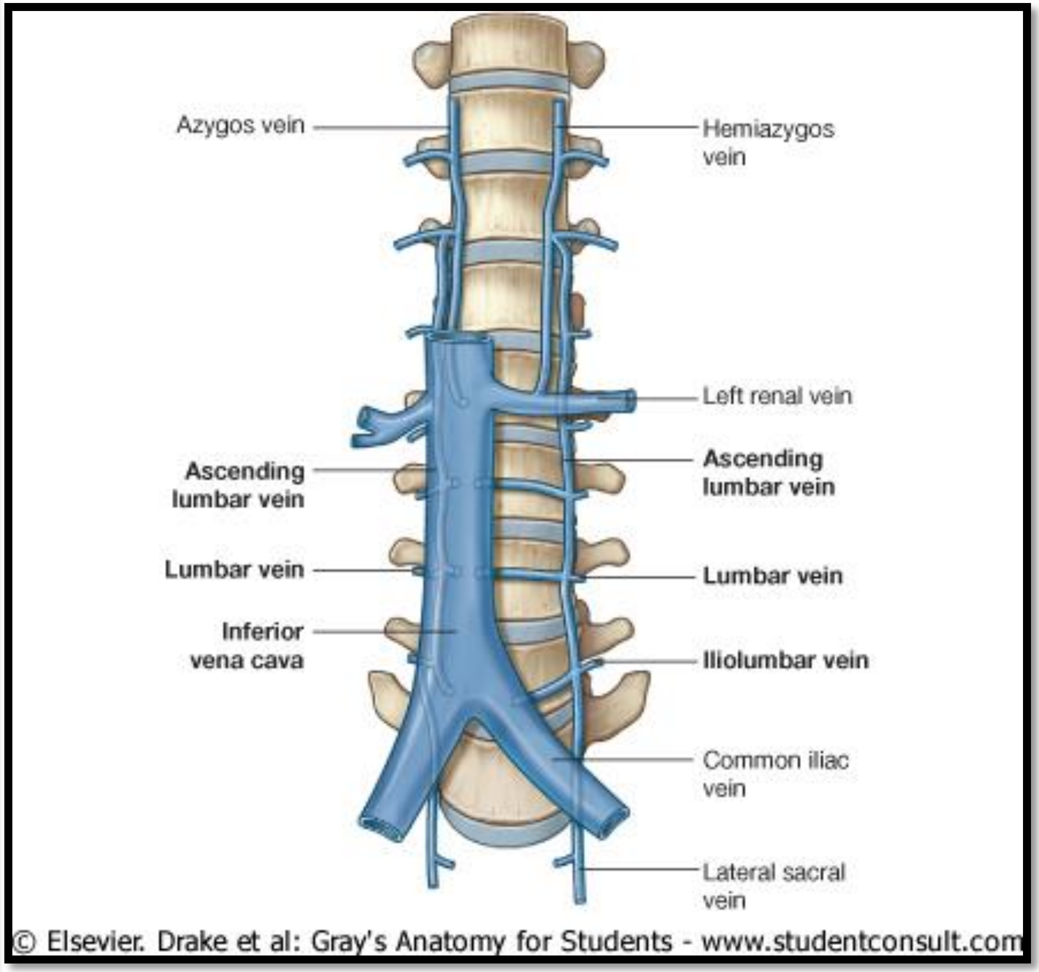

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Tributaries to the inferior vena cava include

- **The common iliac veins.**
- **The lumbar veins.**
- **The right testicular or ovarian vein.**
- **The renal veins.**
- **The right suprarenal vein.**
- **The inferior phrenic veins.**
- **The hepatic veins.**

Lumbar veins

- **The 5th lumbar vein drains into the iliolumbar vein, a tributary of the common iliac vein.**
- **The 3rd and 4th lumbar veins drain into the inferior vena cava.**
- **the 1st and 2nd lumbar veins empty into the ascending lumbar veins.**

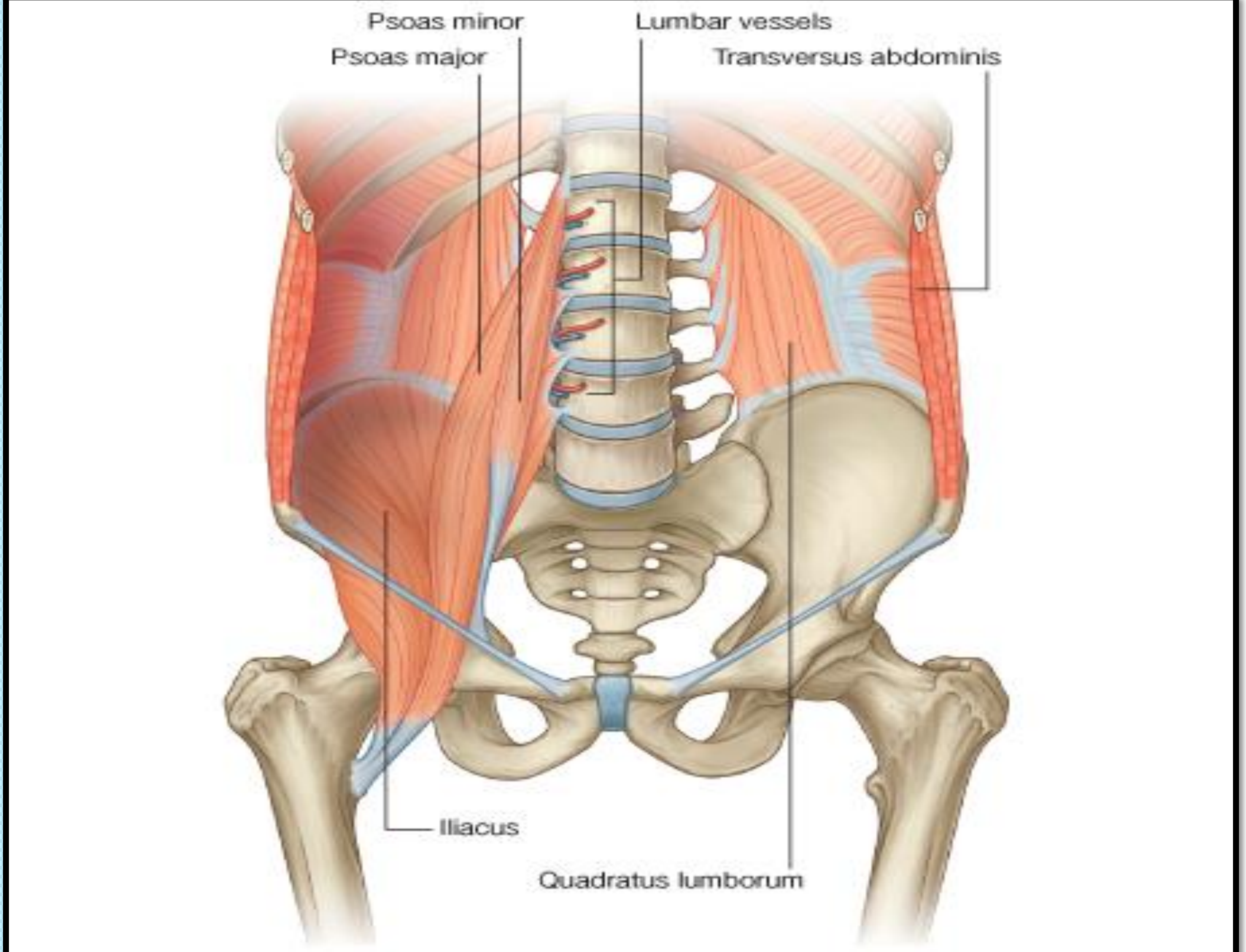
Lecture's map

- Kidneys and ureters.
- Blood vessels.
- **Muscles.**
- **Nerves.**

MUSCLES

Muscles

- Psoas (major and minor).
- Quadratus lumborum.
- Iliacus.



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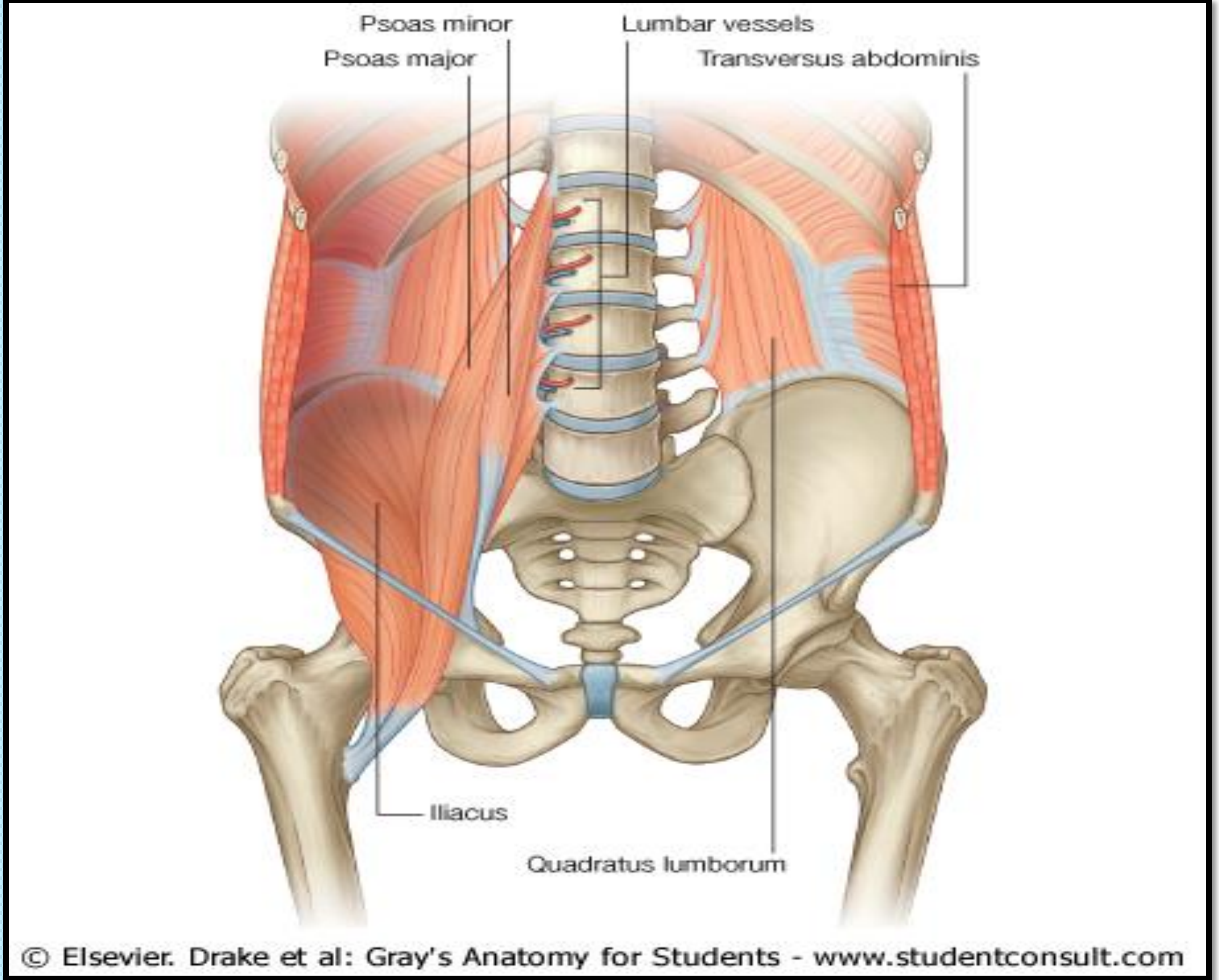
Muscle	Origin	Insertion	Innervation	Function
Psoas major	**Lateral surface and intervertebral discs of bodies of T12 to L5 vertebrae, Transverse processes of the lumbar vertebrae.**	**Lesser trochanter of the femur**	**Anterior rami of L1 to L3**	**Flexion of thigh at hip joint**
Psoas minor	**Lateral surface of bodies of TXII and LI vertebrae and intervening intervertebral disc**	**Pectineal line of the pelvic brim and iliopubic eminence**	**Anterior rami of L1**	**Weak flexion of lumbar vertebral column**



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Muscle	Origin	Insertion	Innervation	Function
Quadratus lumborum	Transverse process of L5 vertebra Iliolumbar ligament Iliac crest	Transverse processes of L1 to L5 vertebrae and inferior border of rib 12	Anterior rami of T12 to L4	Depress and stabilize rib XII and some lateral bending of trunk
Iliacus	Upper two-thirds of iliac fossa Anterior sacro-iliac iliolumbar ligaments	Lesser trochanter of femur	Femoral nerve (L2 to L4)	Flexion of thigh at hip joint

Fasciae

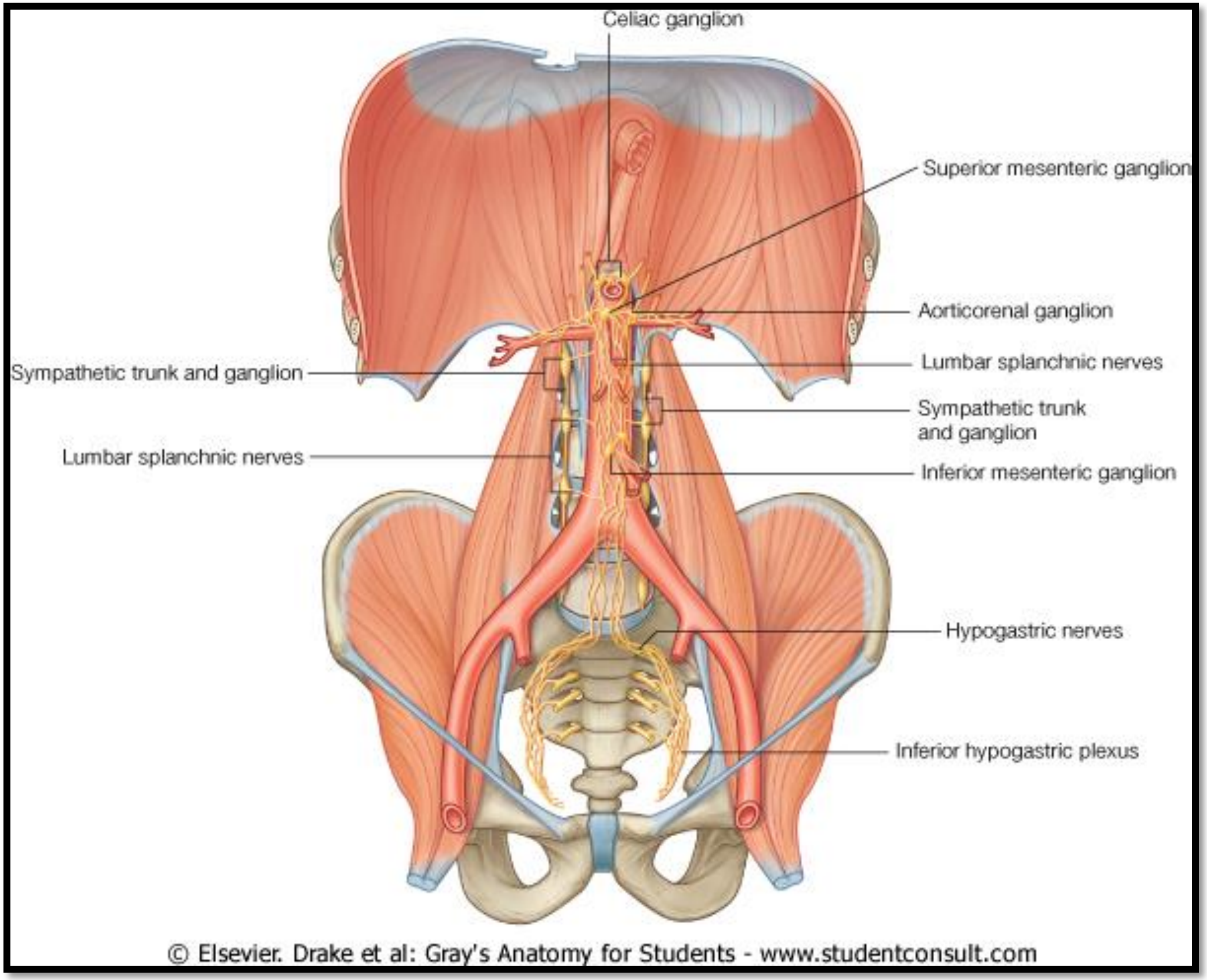
- **Psoas fascia.**
- **Iliacus fasica.**
- **Thoraco-lumbar fascia.**

Lecture's map

- Kidneys and ureters.
- Blood vessels.
- Muscles.
- **Nerves.**

NERVES

Sympathetic Trunks
Lumbar Splanchnic Nerves


Celiac ganglion
Superior mesenteric ganglion
Aorticorenal ganglion
Sympathetic trunk and ganglion
Lumbar splanchnic nerves
Lumbar splanchnic nerves
Sympathetic trunk and ganglion
Lumbar splanchnic nerves
Inferior mesenteric ganglion
Hypogastric nerves
Inferior hypogastric plexus

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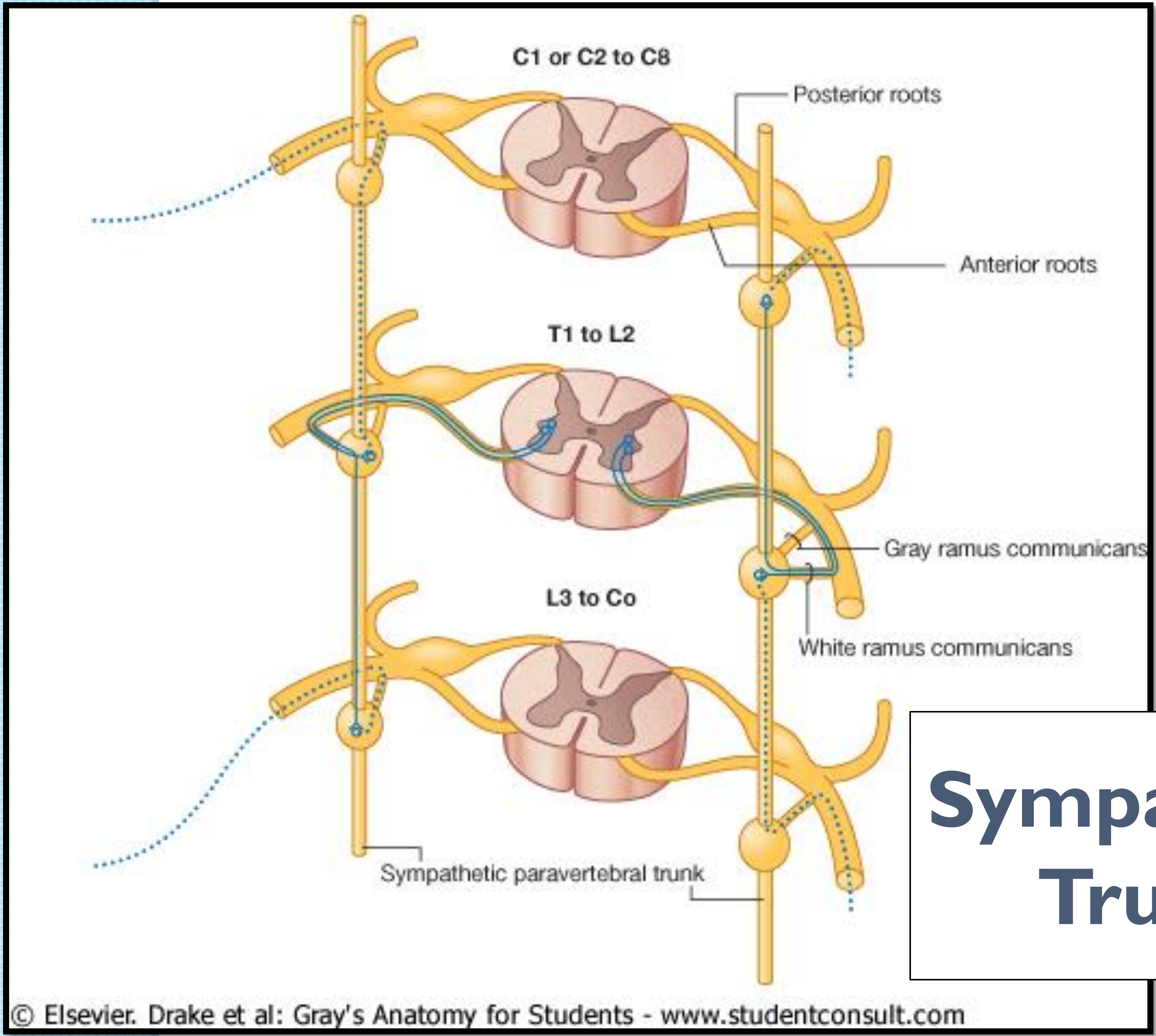

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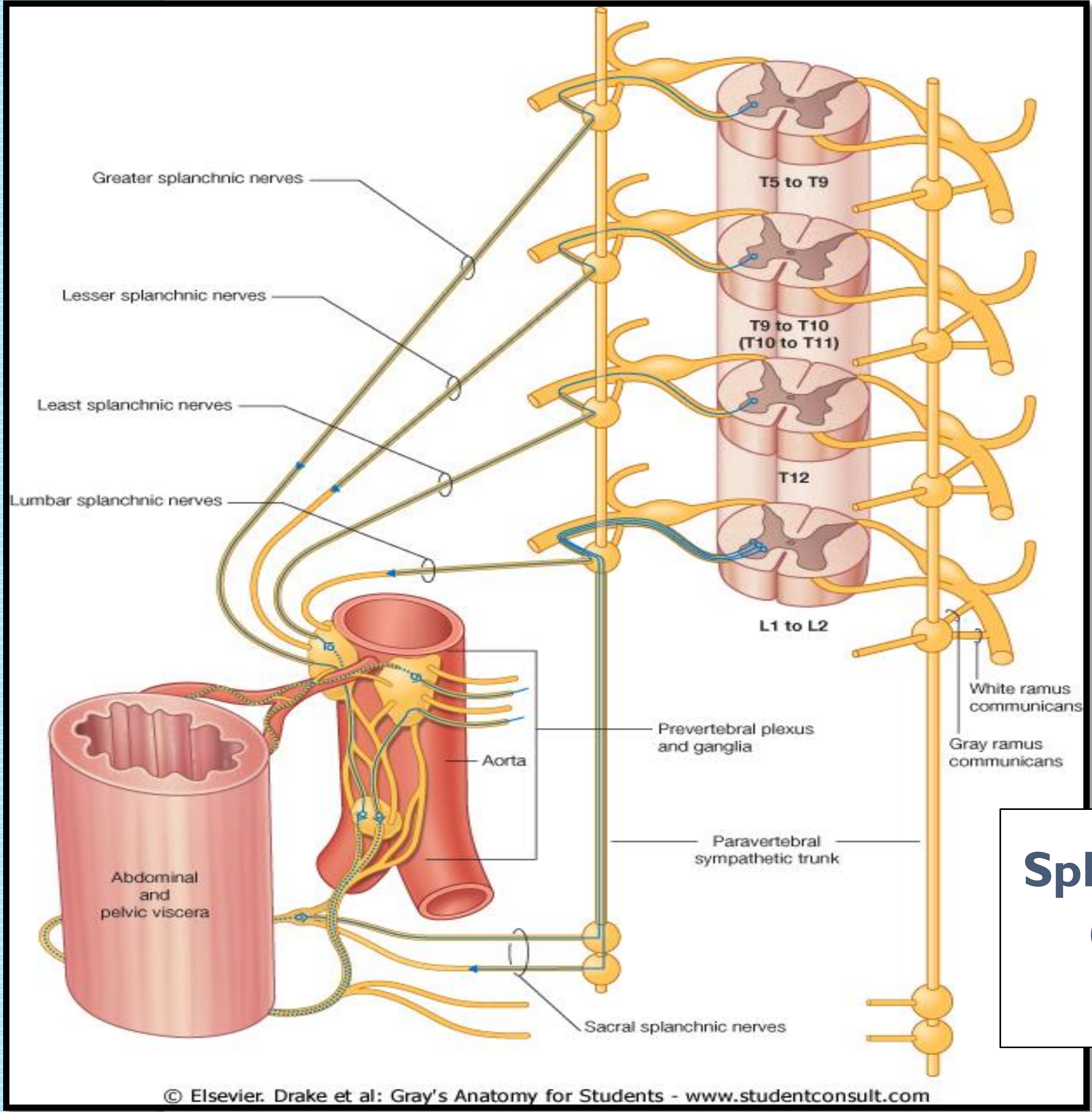
Sympathetic Trunks



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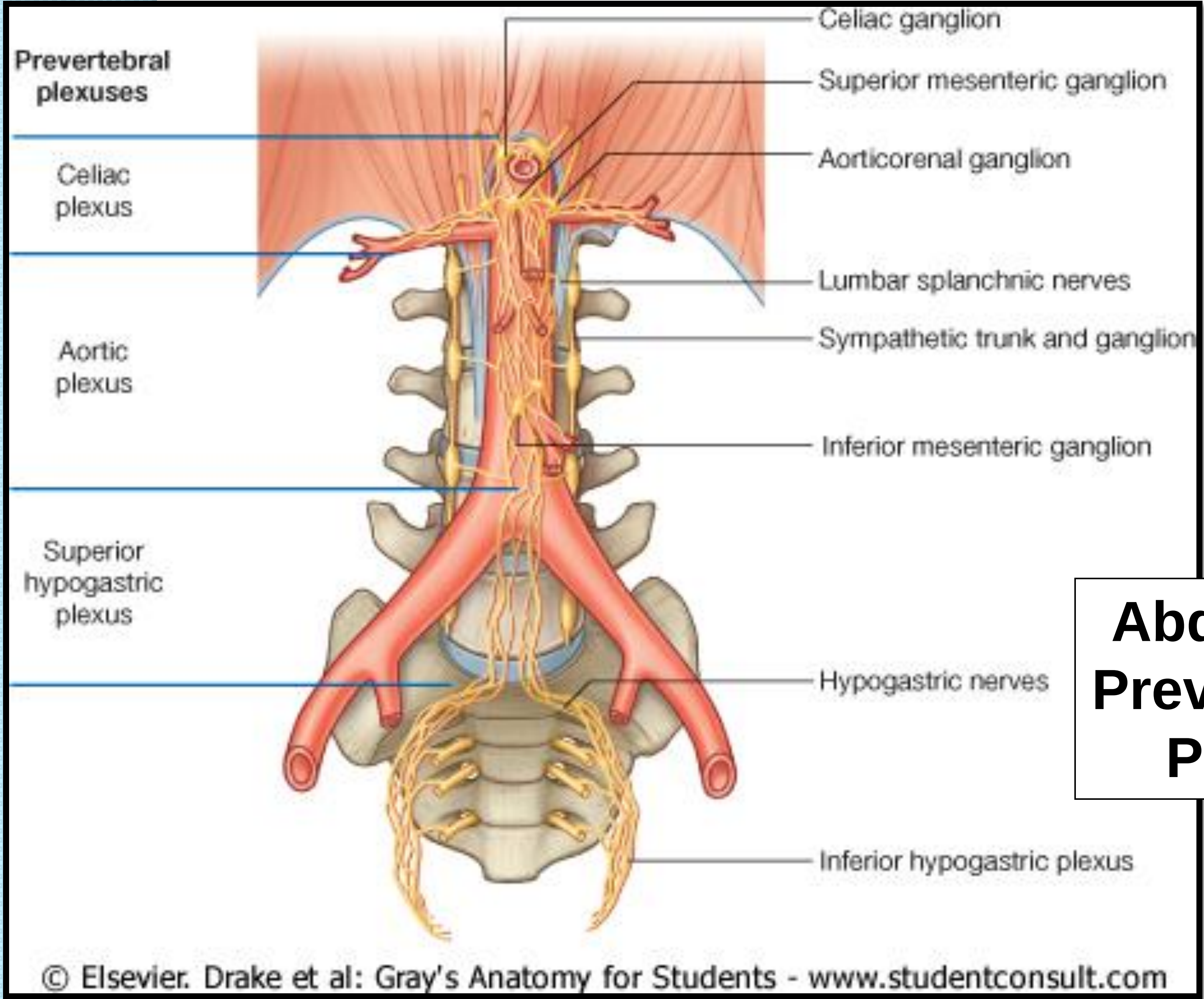
Splanchnic nerves (lumbar and thoracic)

Abdominal Prevertebral Plexus

- Celiac plexus.
- Abdominal aortic plexus.
- Superior hypogastric plexus.


Prevertebral plexuses
Celiac plexus
Aortic plexus
Superior hypogastric plexus
Celiac ganglion
Superior mesenteric ganglion
Aorticorenal ganglion
Lumbar splanchnic nerves
Sympathetic trunk and ganglion
Inferior mesenteric ganglion
Hypogastric nerves
Inferior hypogastric plexus

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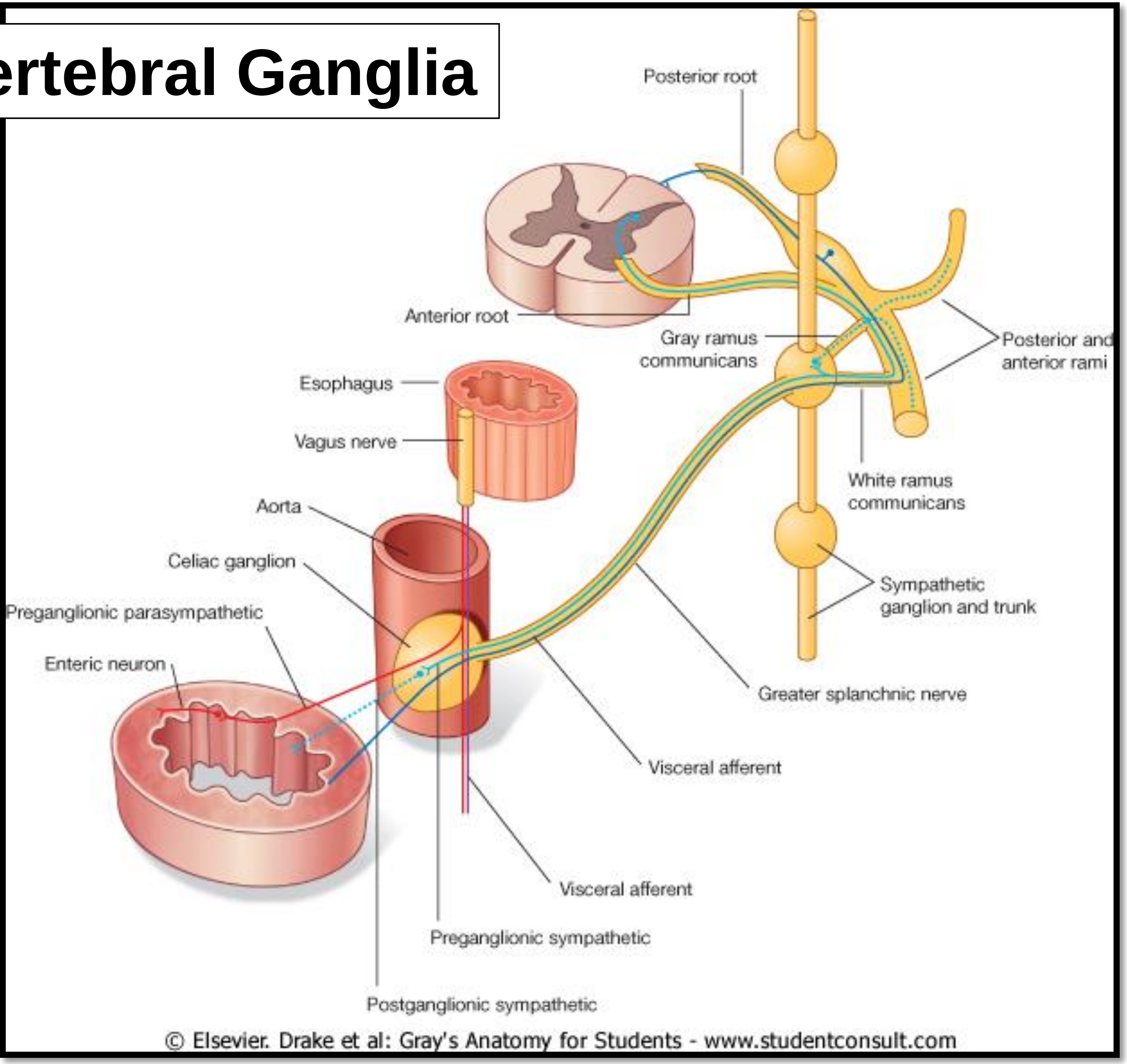
Abdominal Prevertebral Plexus

The Prevertebral Ganglia

- They are collections of postganglionic sympathetic neuronal cell bodies along the abdominal prevertebral plexus:
  - Celiac.
  - Superior mesenteric.
  - Aorticorenal.
  - Inferior mesenteric.

The Prevertebral Ganglia



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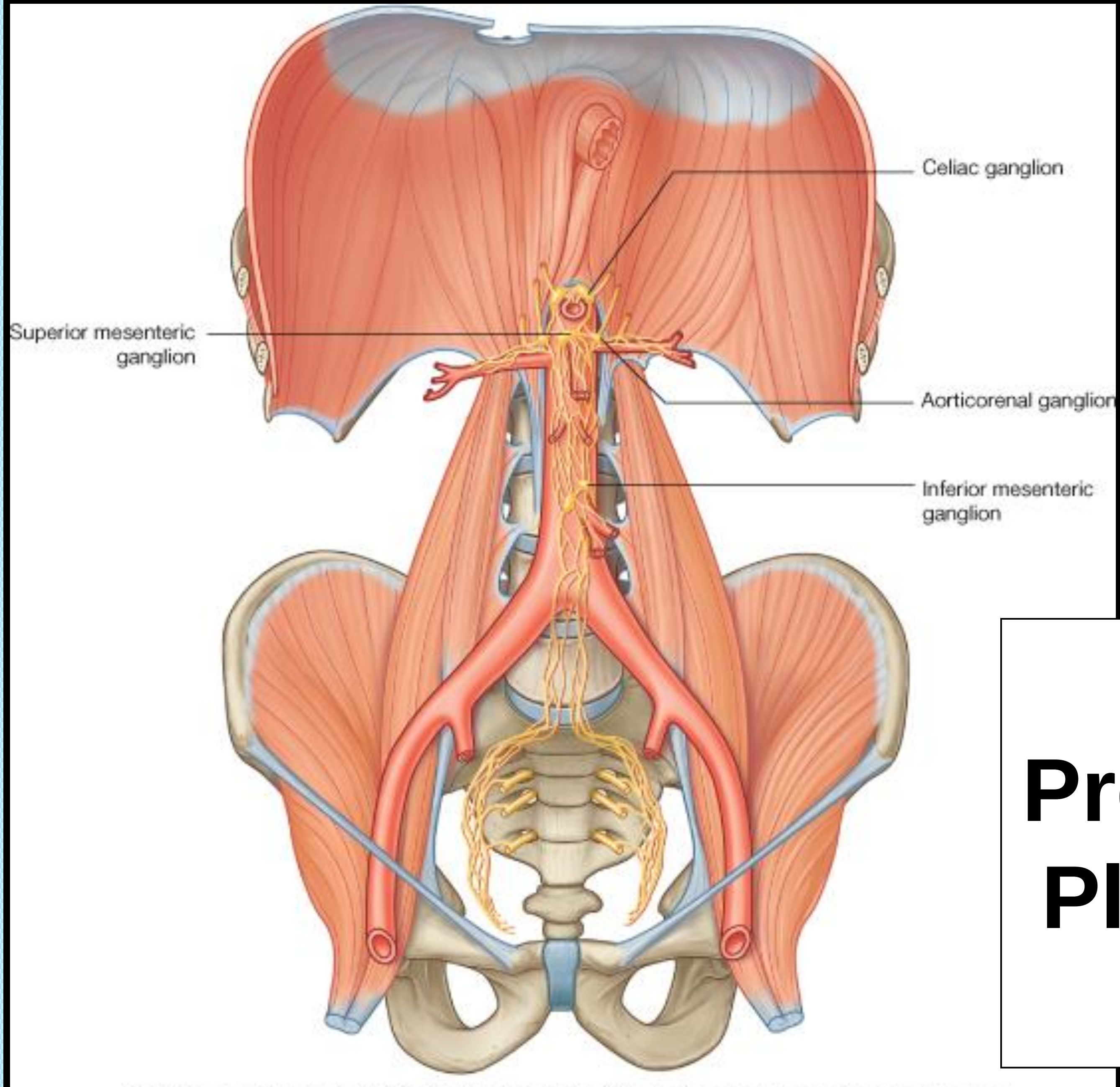
The Prevertebral Plexus And Ganglia



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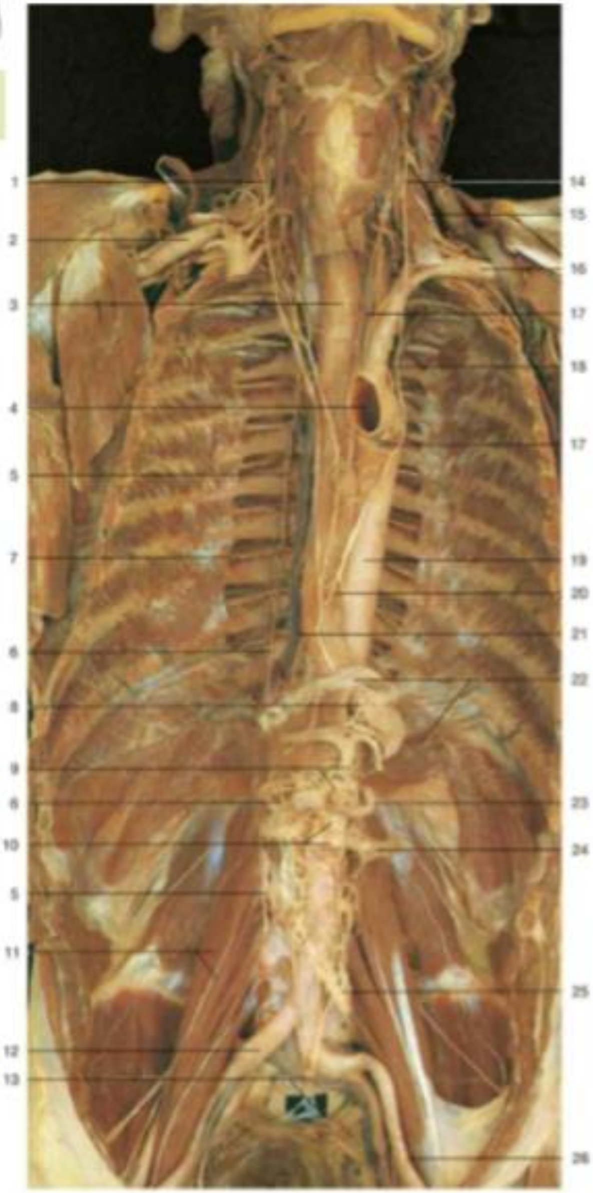
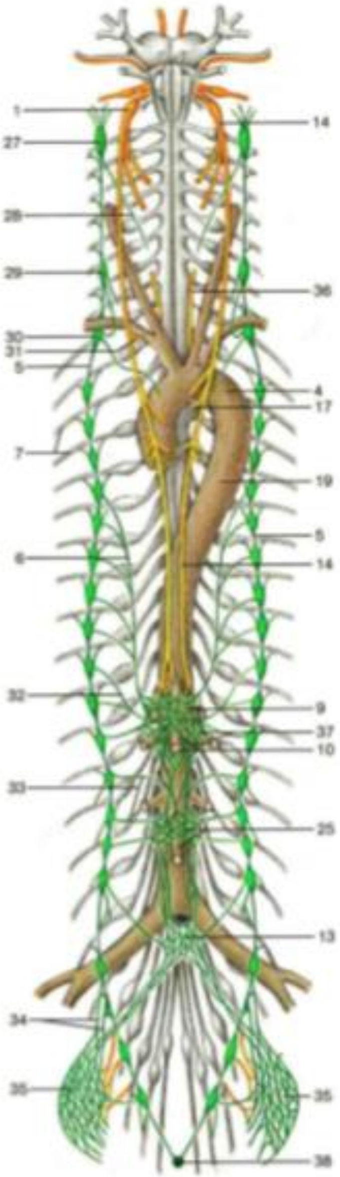


Posterior wall of thoracic and abdominal cavities with sympathetic trunk, vagus nerve, and autonomic ganglia (anterior aspect). Thoracic and abdominal organs removed, except for the esophagus and aorta.



Organization of autonomic nervous system (after Mattuschka). (Schematic drawing.) Yellow – parasympathetic nerves; green – sympathetic nerves.

Nerves Of The Posterior Abdominal Wall

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

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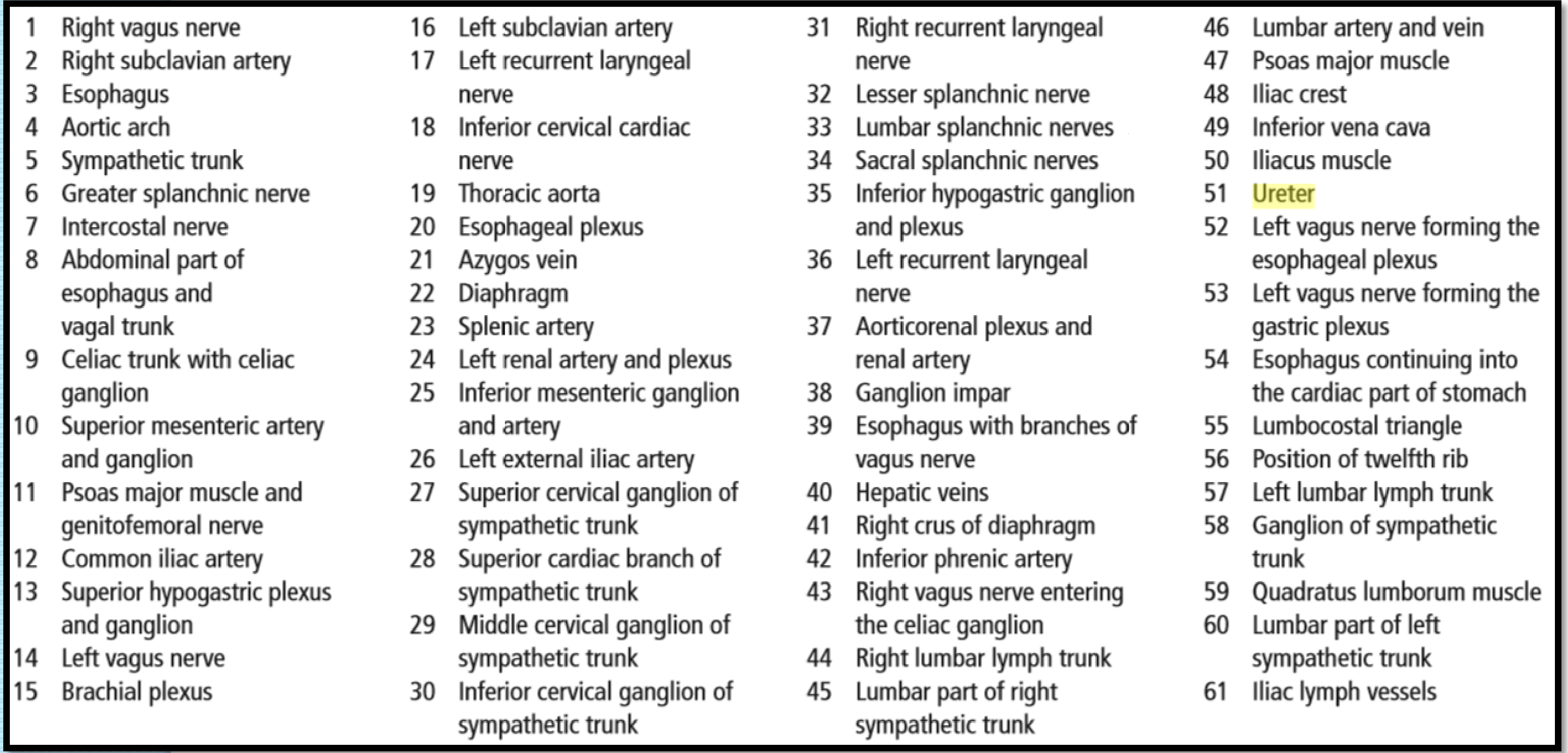
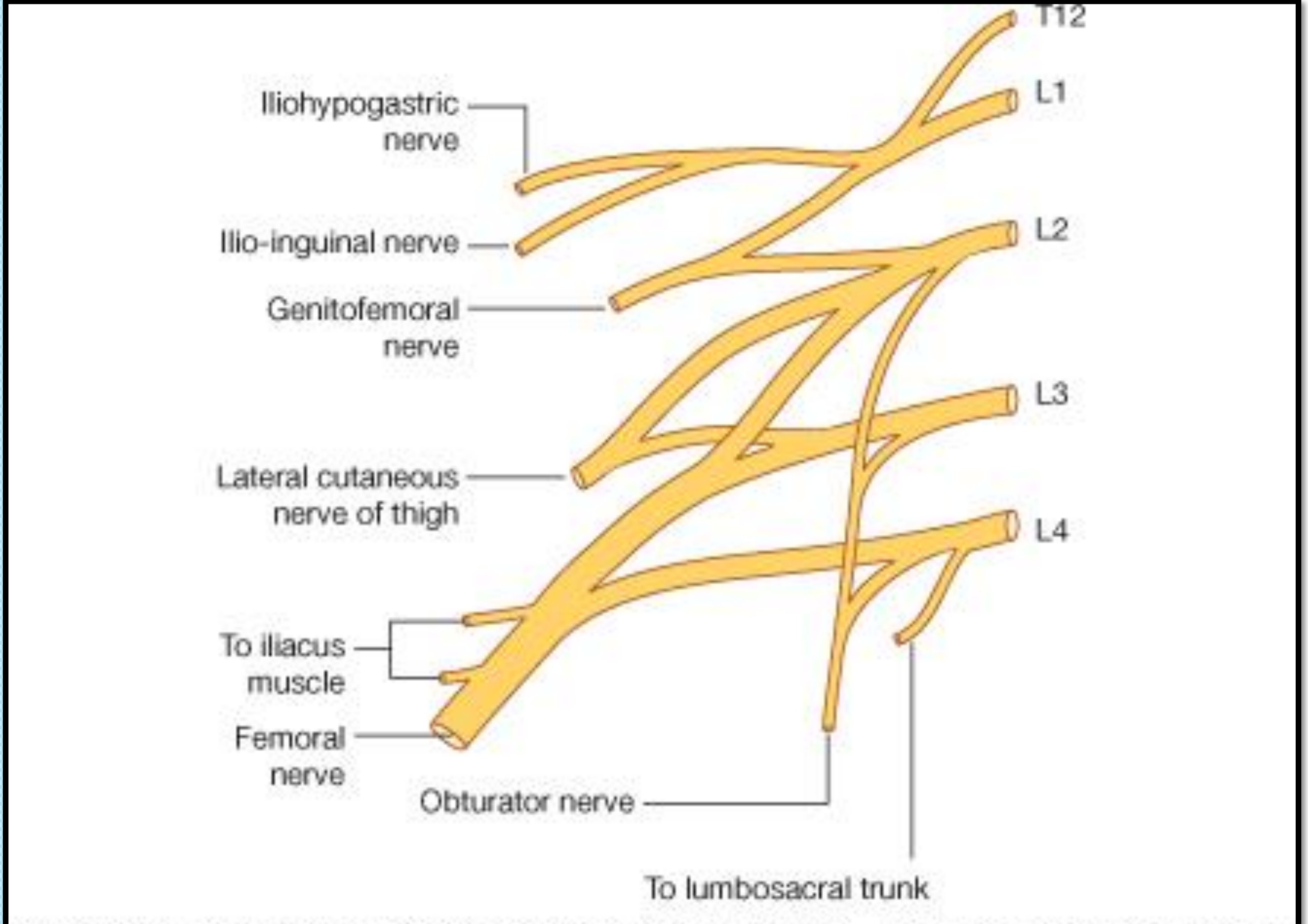


1 Right vagus nerve
2 Right subclavian artery
3 Esophagus
4 Aortic arch
5 Sympathetic trunk
6 Greater splanchnic nerve
7 Intercostal nerve
8 Abdominal part of esophagus and vagal trunk
9 Celiac trunk with celiac ganglion
10 Superior mesenteric artery and ganglion
11 Psoas major muscle and genitofemoral nerve
12 Common iliac artery
13 Superior hypogastric plexus and ganglion
14 Left vagus nerve
15 Brachial plexus
16 Left subclavian artery
17 Left recurrent laryngeal nerve
18 Inferior cervical cardiac nerve
19 Thoracic aorta
20 Esophageal plexus
21 Azygos vein
22 Diaphragm
23 Splenic artery
24 Left renal artery and plexus
25 Inferior mesenteric ganglion and artery
26 Left external iliac artery
27 Superior cervical ganglion of sympathetic trunk
28 Superior cardiac branch of sympathetic trunk
29 Middle cervical ganglion of sympathetic trunk
30 Inferior cervical ganglion of sympathetic trunk
31 Right recurrent laryngeal nerve
32 Lesser splanchnic nerve
33 Lumbar splanchnic nerves
34 Sacral splanchnic nerves
35 Inferior hypogastric ganglion and plexus
36 Left recurrent laryngeal nerve
37 Aorticorenal plexus and renal artery
38 Ganglion impar
39 Esophagus with branches of vagus nerve
40 Hepatic veins
41 Right crus of diaphragm
42 Inferior phrenic artery
43 Right vagus nerve entering the celiac ganglion
44 Right lumbar lymph trunk
45 Lumbar part of right sympathetic trunk
46 Lumbar artery and vein
47 Psoas major muscle
48 Iliac crest
49 Inferior vena cava
50 Iliacus muscle
51 Ureter
52 Left vagus nerve forming the esophageal plexus
53 Left vagus nerve forming the gastric plexus
54 Esophagus continuing into the cardiac part of stomach
55 Lumbocostal triangle
56 Position of twelfth rib
57 Left lumbar lymph trunk
58 Ganglion of sympathetic trunk
59 Quadratus lumborum muscle
60 Lumbar part of left sympathetic trunk
61 Iliac lymph vessels

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

Nerves

- Subcostal (T12).
- Ilioinguinal and iliohypogastric nerves (L1).
- Genitofemoral (L 1and 2).
- Femoral (L 2,3 and 4).
- Obturator (L 2,3 and 4).
- Lateral femoral cutaneous (lateral cutaneous nerve of the thigh).



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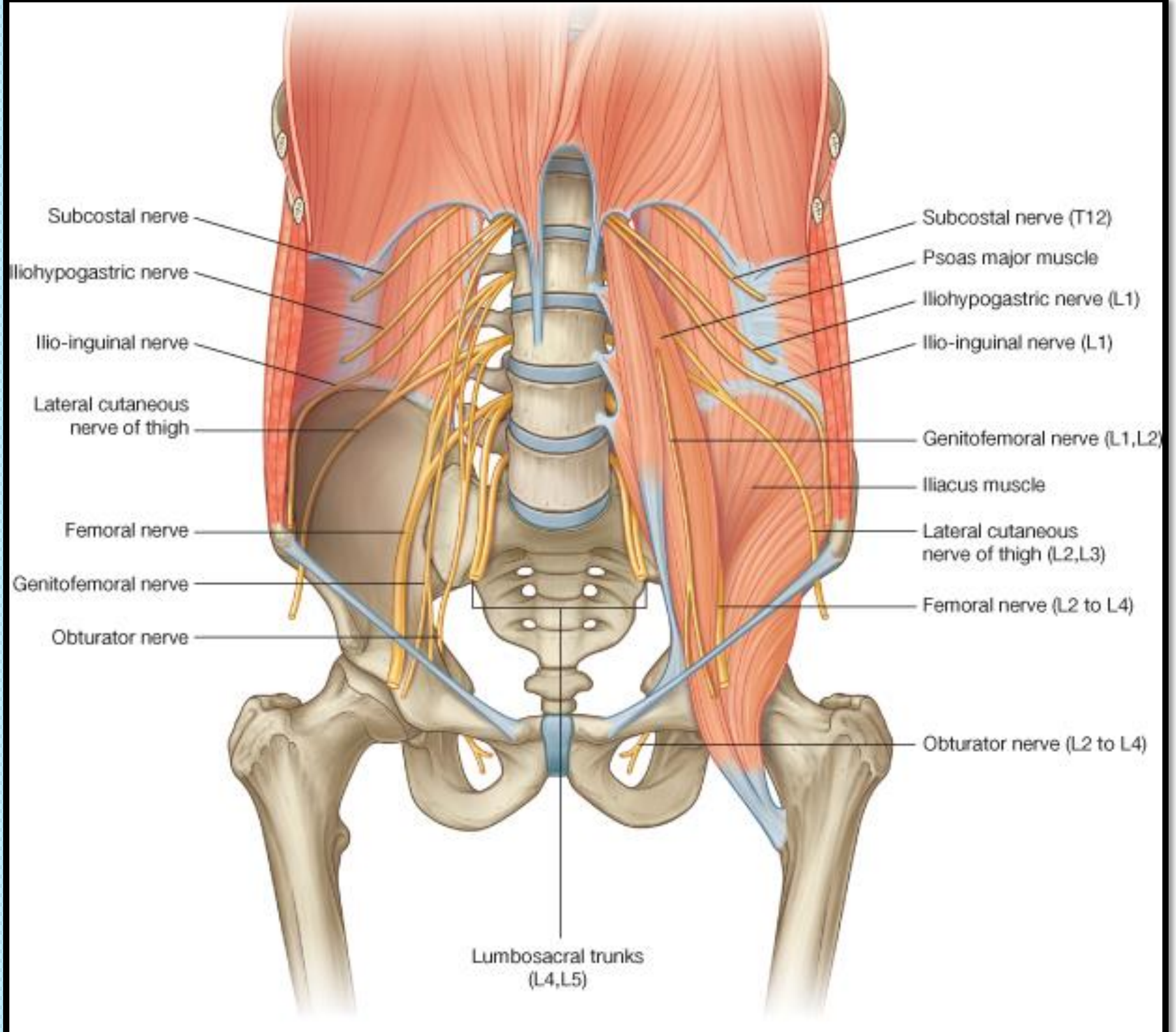

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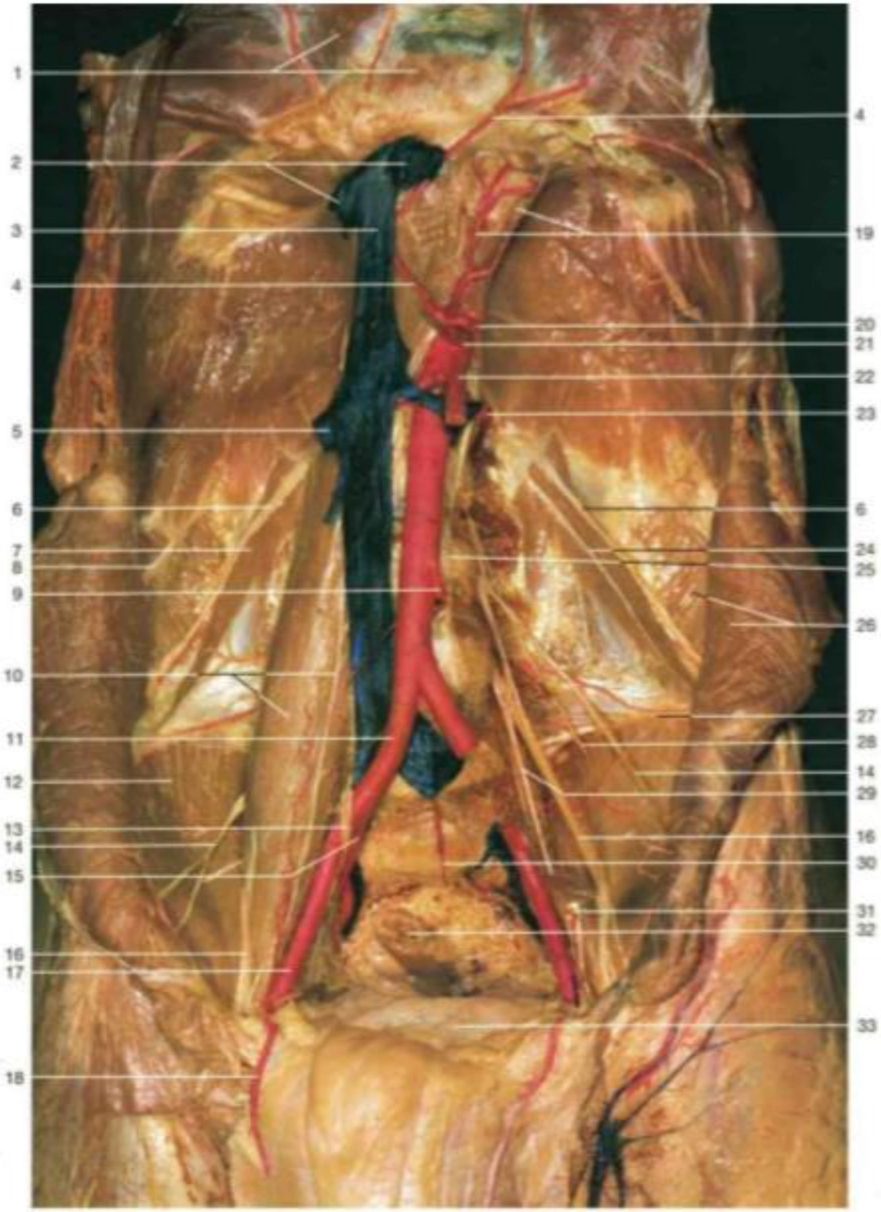
Nerves And Vessels Of The Posterior Abdominal Wall



Vessels and nerves of posterior abdominal wall (anterior aspect). Part of the left psoas major muscle has been removed to display the lumbar plexus. Red = arteries; blue = veins.

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

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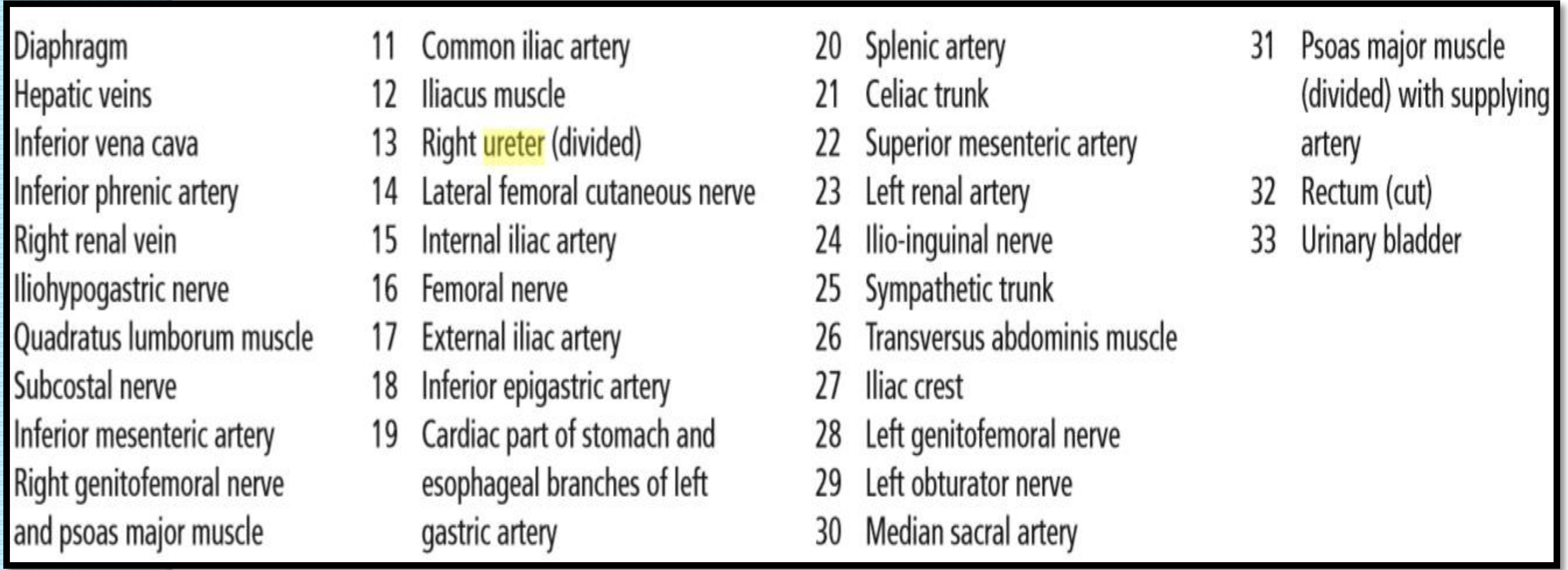

Diaphragm
Hepatic veins
Inferior vena cava
Inferior phrenic artery
Right renal vein
Iliohypogastric nerve
Quadratus lumborum muscle
Subcostal nerve
Inferior mesenteric artery
Right genitofemoral nerve and psoas major muscle

11 Common iliac artery
12 Iliacus muscle
13 Right ureter (divided)
14 Lateral femoral cutaneous nerve
15 Internal iliac artery
16 Femoral nerve
17 External iliac artery
18 Inferior epigastric artery
19 Cardiac part of stomach and esophageal branches of left gastric artery

20 Splenic artery
21 Celiac trunk
22 Superior mesenteric artery
23 Left renal artery
24 Ilio-inguinal nerve
25 Sympathetic trunk
26 Transversus abdominis muscle
27 Iliac crest
28 Left genitofemoral nerve
29 Left obturator nerve
30 Median sacral artery

31 Psoas major muscle (divided) with supplying artery
32 Rectum (cut)
33 Urinary bladder

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

Summary: Lecture's map

- Kidneys and ureters.
- Blood vessels.
- Muscles.
- Nerves.

Please Try To Answer The Following Question:

- The right kidney is related anteriorly to:

a) The spleen.
b) The stomach.
c) The pancreas.
d) The duodenum.
e) The left colic flexure

Please Try To Answer The Following Question

- **The ilioinguinal nerve is derived from:**
  a) **T1.**
  b) **T12.**
  c) **L1.**
  d) **L2.**
  e) **S1**

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